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Economics of Producer Gas, Fuel Oil and Natural Gas Compared

(IN FIVE PARTS)

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Part 1.

Statement of the Problem

QUITE frequently, in the manufacture of glass the question of fuel economics arises. Producer gas may or may not be functioning satisfactorily as a fuel for glass tanks or furnaces; however, attractive fuel oil prices are developed or a surplus of natural or other gas fuel may be available at apparently low prices. Fuel price developments are important and always demand consideration as fuel expense is a big item in glass manufacturing cost. Before it is possible to make an intelligent decision regarding purchase, the economics of the fuels must be investigated. In some instances tests under actual and constant conditions can be made and equivalent fuel values calculated therefrom. However in many cases tests cannot be made without great expense and it is impractical to carry out the experimental work. The object in developing this subject is to present a theoretical method of comparing fuels. The comparisons presented in the succeeding chapters are for a continuous regenerative glass tank. Figure I shows a typical tank with information pertaining to the method of applying fuels.

Some practical glass men may feel that a theoretical solution of this problem is dangerous. However if constant tank pull and temperature conditions are used throughout the calculations, the results will be close to actual providing the fundamental steps are followed closely.

Comparisons of fuels may be made on a direct B.T.U. basis involving only the unit heat contents, but this method does not take into consideration flame temperatures and flame temperatures are very important in the fuel requirements of tanks wherein are maintained the high temperatures used for melting glass batch. The heat transfer from the combustion of a fuel varies with the flame temperature, flame luminosity and the temperature of the glass bath. The greater the differential between flame temperature and glass bath temperature the better will be the use of heat. The fuel-temperature curve rises sharply as the glass or tank temperature approaches that of the flame. From the above it is seen that safe comparisons cannot be made on a strict B.T.U. basis.

Comparisons either calculated or from actual tests on a basis of pounds of glass per unit of fuel are not reliable except under constant tank pull or load conditions: comparisons may be permitted if all of the batch entering is weighed as it enters the tank and the quantity is kept constant for the period involved. Useful heat in a tank may be said to include the heat required for overcoming the tank losses plus the heat required for melting the batch charged. A glass tank will take about 85 per cent normal full load heat requirements to carry it over an idle day of zero pull: less than 15 per cent of the fuel actually melts batch, the other 85 per cent merely maintains the temperature by overcoming losses due to radiation and convection, etc. Because of uncertainties of tank pull comparisons on this basis are not recommended. If tanks could be insulated so that the percentages were reversed the term "Pounds of glass" per unit of fuel would have much greater value.

A third method, the recommended basis of procedure, involves the analysis of the heat required for maintaining the temperature of the melting and refining chambers plus the heat for melting batch. In this method of attack many variables are safely considered as constants. Assume a constant pull or load for all fuels, constant temperatures of air preheat, a constant melting temperature and constant temperature of waste gases leaving the combustion chamber. The assumptions are basically correct for they are the normal operating conditions.

The heat which enters the tank is the sum of the sensible heat in the fuel, chemical heat in the fuel and the sensible

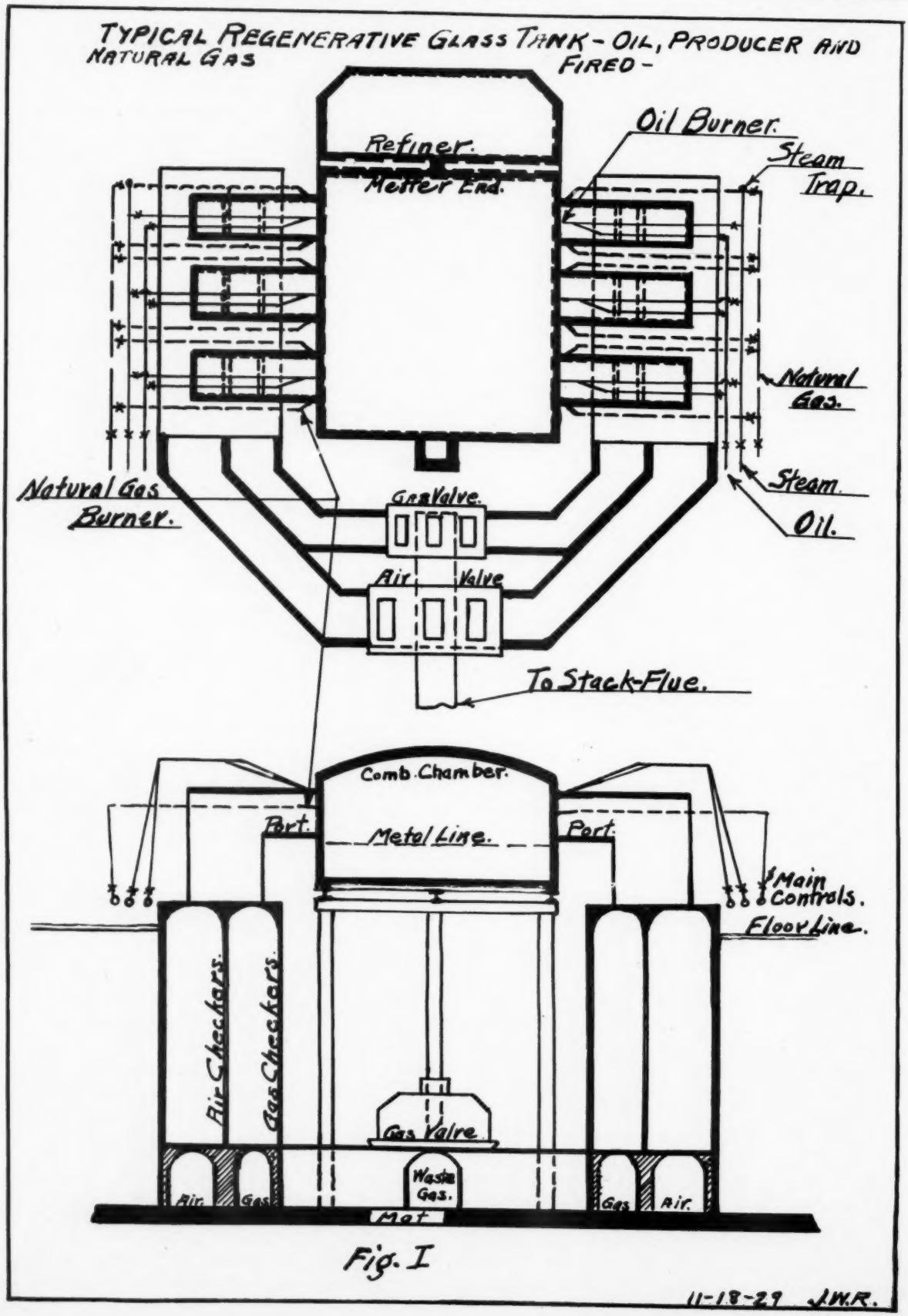
TYPICAL REGENERATIVE GLASS TANK - OIL, PRODUCER AND NATURAL GAS FIRED -
Refiner.
Melter End.
Oil Burner.
Steam Trap.
Natural Gas.
Steam.
Oil.
Natural Gas Burner.
Gas Valve.
Air Valve
To Stack-Flue.
Comb. Chamber.
Port.
Metal Line.
Port.
Main Controls.
Floor Line.
Air Checkers.
Gas Checkers.
Gas Valve
Waste Gas.
Air.
Gas.
Gas.
Air.
Mat.
11-18-29 J.W.R.

Fig. I

heat in the air. In the case of fuel oil sensible heat in steam used for atomization is included. Heat leaving the combustion chamber assumes complete combustion and includes only the sensible heat in the waste gases at the exit ports. A very important consideration in calculating fuel merits is the proper selection of data so that it represents normal operating conditions. Of the data the air and gas preheat temperatures for actual checkerwork volume and reversal periods must be arrived at by using average values over the cycle taking readings in the several port necks. With each fuel there is a net delivery of heat to the combustion chamber and by comparing these net deliveries quantitatively the relative merits of fuels are easily determined.

Following out the above reasoning the comparison of producer gas, fuel oil and natural gas is carried out in sufficient detail so that it can be used as a guide by anyone desiring to work out fuel economics. Fuel, steam and water costs only are developed because capital investments and fixed charges for fuel handling and use vary widely. However, the combination of fixed charges on unit fuel bases is relatively simple once the fuels are reduced to terms of one fuel preferably the fuel normally used.

The second chapter will show data and calculations for producer gas which is assumed as the fuel normally used. In the third chapter fuel oil calculations are given, the fourth covers natural gas while the fifth is devoted to comparisons of the fuels and to discussions.

Chromium Plating Technique *in the Glass Industry*

by FRANK P. ROMANOFF

MUCH has been published in the past few years on the subject of chromium plating, and nearly every field of industry has had something or other covered with chromium for experimentation if not for actual production.

The automobile, machinery, food, clothing, printing, weaving, rubber, oil, and many other industries are utilizing chromium plated equipment of parts for one or more of the following purposes:

Corrosion resistance at low or high temperature.
Abrasion and wear resistance.
Color and appearance.
High reflectivity.
Low coefficient of friction.
Heat resistance.

Some of the more persistent glass manufacturers have also found that chromium plated machinery can be adapted in the industry with beneficial results. Where failures have been encountered, fair investigation will often prove that it is the processing that is at fault and not the process. The processing of electrolytic chromium deposition is the main factor which usually will determine the success or failure of the metal coating in service.

Chromium plating of glass molds has been attempted through jobbers mostly, in this country. The results have not been too encouraging, but in a few cases has led to the establishment of plating departments equipped to plate the more intricate and expensive molds, where sharp design was necessary and many pressings required. Those manufacturers wishing to plate rollers have usually found that jobbers were seldom equipped to do these right. Some of the factories have been more or less forced to install experimental plants, which were not always successful. Most of the difficulty lies in the attempt to operate on a cut and try basis entirely.

Successful chromium plating of molds and rollers, if systematized, can lead to great savings without disturbing present manufacturing methods. The deposit accentuates all lines and details on the molds. The resistance to corrosion and abrasion greatly prolongs the life of molds and rollers. The savings entailed can readily be surmised. The greatest difficulty in the way of most glass manufacturers who desire the utilization of the metal chromium is the lack of knowledge of the important detail required in chromium deposition. This article attempts to present a working basis for the practical plating of glass molds and rollers, as well as other objects.

Some theory is incorporated to enable the manufacturer to intelligently overcome those difficulties most likely encountered. An excellent article on the adaptability of chromium plate to glass molds is included in THE GLASS INDUSTRY, *Vol.* 9, *No.* 2 (1928). The paper illustrates the usage of a chromium plant in a glass factory and gives some ideas of the practice in Germany.

In using chromium, care must be taken, first of all, to ascertain that the service required does not demand conditions impossible of fulfillment by a deposit of the thickness used. In deciding upon the use of chromium plate, its adaptability for the purpose must first be questioned.

Table I is a list of the physical properties of chromium compared with several other metals.

Table II represents the effect of a few reagents on pure chromium and on a thin deposit of chromium on iron.

It will be noticed from Table II that although pure chromium may withstand the attack of certain reagents, it does not follow that a deposit of the metal on another material will protect the latter from attack by corrosive agents to which they are usually susceptible.

The base metal plays an important part in the protective ability of chromium deposits due to several considerations. First, let us assume a chromium deposit directly on cast iron. If the deposit were absolutely uniform and nonporous, it will follow the behavior of pure chromium metal, as set forth in Column I of Table II. However, deposits of chromium are seldom free from pores and pin-holes.

Table I

PHYSICAL PROPERTIES OF SOME METALS	Density	Coefficient of Linear Expansion $\times 10^{-6}$	Melting Point °C.	Resistivity $\times 10^{-6}$ Ohm—Cm.	Reflectivity at Max. Visual Intensity	HARDNESS: Brinell	HARDNESS: Sclerescope	HARDNESS: Sapphire Scratch Width in Microns	HARDNESS: Smithsonian Scale Diamond=10	Electrode Potential	Coefficient of Friction
						(500)*		.7**			
Chromium	7.1	.08	1615°	2.6	.70	950	110	2.1*	9	—.47	.12
Nickel	8.8	.13	1452	7.5	.63	420	55	3.7	4	—.20	.18
Iron	7.8	.11	1530	10.0	.55	100	30	—	5	—.34	.17
Steel — Soft	7.5±	.10±	1400±	11.±	.54 ±	130	75	2.2	5	—	—
Steel — Case Hardened						590	105	1.2	8.5	—	—
Copper	8.9	.15	1100	1.6	—	—	12	—	3	+.35	.18
MISCELLANEOUS		.09 Platinum		2.6 Aluminum	.91 Silver .71 Mirror	2000 Carboloy				—.77 Zinc —.40 Cadmium	

This results in attack upon the base metal as seen from Column II. In this case a light deposit of chromium on cast iron results in the lifting or peeling of the chromium deposit. This is not due to attack of the chromium itself. The true corrosion process takes place on the iron alone. The pores in the thin deposit of chromium permits the reagents to find their way to the iron. Instead of general corrosion of the iron, we have a localized corrosive process set up resulting in greater damage than if there were no chromium at all present. Although at first the iron may be attacked chemically, the real damage is done by electrochemical attack. A corrosion couple is set up between the chromium and the iron, the latter serving as the positive pole or anode, consequently dissolving.

Table II

	I	II
Acetic acid	N	RP
Nitric acid (concentrated)	N	N
Sulphuric acid (concentrated)	N	RP
Fruit acids	N	RP
Phenol	N	RP
Perspiration	N	RP
Ammonium hydroxide	N	SlP
Molten zinc	N	RP
Molten copper	Sl	RP
Molten tin	N	RP
Molten lead	N	RP
Molten glass	N	RP

Column I represents pure chromium.

Column II represents a 10-minute deposit of chromium on cast iron.

N—No attack. Sl—Slight attack. R—Rapid attack. P—Peeling off of the chromium deposit.

Fig. 1 illustrates the mechanism by which the corrosion process causes removal of the chromium deposit. Corrosion is especially vicious under these conditions, because even after the chromium has flaked, the corrosion product may form a membrane which excludes oxygen from the part of the iron already corroded. An oxygen cell is set up which can result under certain conditions, in total removal of that part of the iron to which air or oxygen has no access. Fig. 2 shows the effect of this on iron, while Fig. 3 illustrates an experiment whereby the exact mechanism can be determined with the aid of a millivoltmeter. This indicates the direction of the current flowing between two identical pieces of metal immersed in an electrolyte. One piece is in a chamber to which air is excluded. The other is in an aerated chamber. Both compartments are connected as shown, to permit the current to flow between the two pieces of metal. Porous chromium, as well as the corrosion products, may serve as a membrane to exclude the air from portions of the iron, which then corrode.

From the above considerations it can be ascertained that if corrosion resistance is desired, a thin, porous deposit of chromium will not be satisfactory. In the deposition of heavy deposits of chromium, it is found that they are difficult to obtain free from penetrating cracks, which are equivalent to pores in their action. Fig. 4 illustrates the form the cracks take in heavy deposits. This type of plate is nearly always filled with networks of cracks. The condition is due to the enormous stress set up in the hard metal during deposition. If these networks result in combinations as shown at A, Fig. 4, corrosive reagents will eventually find their way to the base metal and result in the peeling of the chromium. If, however, the network is of the type B, the reagents cannot penetrate all the way through to the base

metal, resulting in complete protection, in spite of the presence of the cracks. This closed network is the result of the bridging over of the chromium deposit after a crack develops.

Successful chromium deposition for the purpose of corrosion resistance when applied directly to steel or iron, resolves itself into obtaining a plate free from pores, pits, and cracks. Where deposits of chromium are utilized for appearance only, requiring resistance to corrosion, the usual custom is to cover the base metal with a deposit of one or more metals. These intermediate deposits are usually non-porous and serve as a base for the deposition of a very thin plate of chromium, seldom over three hundred-thousandths of an inch in thickness. Exposed automobile parts, plumbing supplies, and various other articles are being processed in this way. In some cases, the chromium is deposited directly on brass, using a deposit of one to three ten thousandths inch or better. The cost of this method is usually equal to or greater than that of the composite coats consisting of nickel, copper, and chromium. Experience has not proven the former process to be superior to the latter, due to the tendency to cracked deposits.

In the plating of glass molds, composite coatings are not

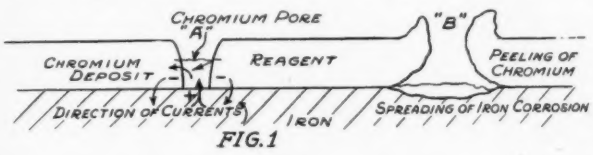

FIG. 1

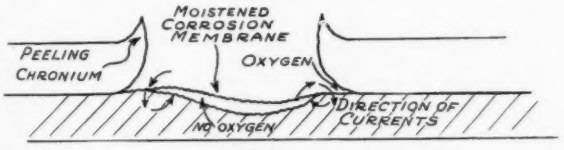

FIG. 2.

practical because of the differences in the coefficients of expansion of the different metals, and also due to the fact that the porosity of thin chromium deposits renders the base metal susceptible to attack by the molten glass with subsequent failure. Heavy deposits of chromium on composite coatings of other metals are impractical because they peel due to the enormous stresses set up. The deposit most desirable would be a heavy, uniform, coating free from cracks. However, a heavy deposit free of all cracks is an ideal which is rather difficult to achieve. With care, deposits can be obtained which contain only a few very fine microscopic cracks of the type shown in Fig. 4B. This type of deposit would be satisfactory for coating glass molds and rollers. A thickness of at least 0.0004 inch would be required, but a much heavier deposit might be necessary for special purposes. The minimum thickness can usually be obtained from most solutions if the deposition is continued for one hour. Chromium plating baths are usually only 10 to 20 per cent efficient and hence the greater length of time required than that calculated from equivalent weights.

Generators

The large current densities required usually demand the use of a very large generator if objects of large areas are to be plated. For plating glass molds or rollers, current densities of 150 to 300 amperes per square foot may be necessary. If only small molds are to be processed, the area of which seldom exceed one-half square foot, a small motor generator set may be used of 150 ampere capacity at 6 to 12 volts. For large rollers or other parts, where large areas are involved, a large motor-generator set of 2000 to 3000 ampere capacity at 6 to 12 volts may be required. The glass

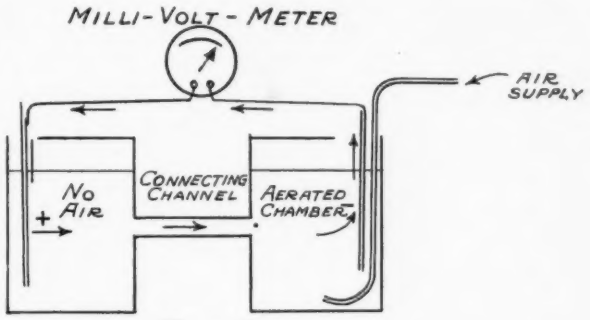

FIG. 3

manufacturer intending to do his own plating can choose his generator from a host of highly improved machines advertised in some plating journals, such as *The Metal Industry*.

An ideal size generator for this type of work would be a 2500 ampere machine. This would permit the plating of rolls having an area of as much as 12 to 15 square feet. If larger rolls are to be plated they may be successfully processed in two parts, or by a process of continuous plating whereby the roll is slowly rotated in the tank, only part of the area of the roller being immersed in the bath during the plating process. The areas given above include that of all holders or contacts (which should be large), exposed to the action of the bath.

Tank

The tank should be of welded steel construction, preferably lead or glass lined. A method of heating and cooling should be provided. The temperature of deposition will depend upon the type and age of the bath, but is usually confined between 100° to 132° F. The temperature chosen must be maintained between very close limits for this type of work. It should not vary by more than 2° to 4° from the required temperature. A thermostatic controller is most

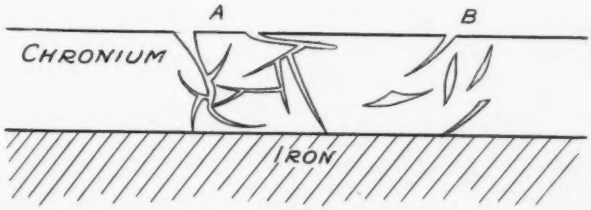

FIG. 4

desirable in chromium plating. Steam or gas may be used to heat the solution. If steam is used a lead steam coil laid on the bottom of the tank is usually satisfactory. This coil can serve for both heating and cooling by interconnection with a cold water supply. If gas heated equipment is used, the tank requires an extra heavy bottom steel plate. It should not be glass lined as the glass may crack

and break. A lead coil should be used for cooling water. All lead linings, pipes and anodes should be of 3 to 6 per cent antimonial lead.

The tank must be equipped with a system of ventilation. This is a very important part of the equipment, and cannot be slighted without serious results. The most satisfactory method of ventilation for chromium plating tanks is the utilization of a low pressure chamber around the upper half of the tank. A duct ½ to 1 inch wide surrounds the tank at the top, and serves to pull the fumes laterally across the surface of the solution into the low pressure chamber. A sort of blanketing effect is obtained over the bath. The air velocity should be greater than 2500 feet per minute at the ducts. If the tank is more than 36 inches wide, this figure should be increased. With this velocity, it is necessary to keep the solution level 6 to 8 inches below the ducts. The poor efficiency of the bath results in the generation of a very large volume of hydrogen gas. The gas carries with it a mist or spray of chromic acid. This attacks the membranes of the nose resulting sometimes in pierced septums and other serious conditions.

Solution

With equipment chosen, the next important requirement is the solution. In 1920, Sargent, at Cornell, published a formula for chromium plating, consisting essentially of

Chromic acid	33 oz.
Sulphate	.3 to .6 oz.
Water	1 gal.

The Bureau of Standards has also recommended this formula, and many independent platers throughout the country are using it with success. Patents have been applied for and granted covering a host of formulas for chromium plating, including Sargent's bath, given above, but not patented by him at the time of publication. The strangest part of the situation is the fact that after operating a short time, analysis shows these baths to be essentially Sargent's with slight, if any, modifications. The most important ingredient in the preparation and maintenance of the bath is the sulphate content. This should always bear a certain ratio to the chromic acid content. From experience this ratio has been found to be 100 to 1. For every 100 pounds of chromic acid, there should be present one pound of sulphate. Chromic acid is readily obtained of very high purity, well over 99 per cent. However, its sulphate content may be as high as 0.25 per cent. This means that for every 100 pounds of chromic acid used, only 0.75 pounds of sulphate should be added. This seemingly slight difference may be the only item governing the success or failure of the bath.

If sulphuric acid is used as a source of sulphate, the amount of the latter required may be obtained by weighing out the same amount of sulphuric acid. If other sources of sulphate are used, such as chromic, sodium, potassium or ammonium sulphates, equivalent amounts to obtain the same ratio of sulphate radical by weight must be used.

The final bath ratio should be

$$\frac{\text{Chromic acid } (CrO_3)}{\text{Sulphate } (SO_4)} = \frac{100}{1} \text{ by weight}$$

If a solution containing 33 ounces per gallon of chromic acid is used, 0.33 ounces of sulphate should be present. If more sulphate is present than required, additions of chromic acid to as much as 55 ounces per gallon may be made to obtain the proper sulphate ratio. Another method of reducing the sulphate content if too high, is the addition of barium chromate or hydroxide, which will precipitate the excess sulphate.

It has been found that excellent throwing power, or ability to deposit metal in recesses, is obtained with a solution consisting of

Chromic acid	33 oz.
Sulphuric acid (H_2SO_4)	0.25 c.c. 60°
Water	1 gal.

The temperature of operation is 132° F. The current density should be about 300 amperes per square foot of plating area, obtained at a voltage of 5 to 9 volts, depending upon the distance of the work from the anode, age of the solution, and method of upkeep.

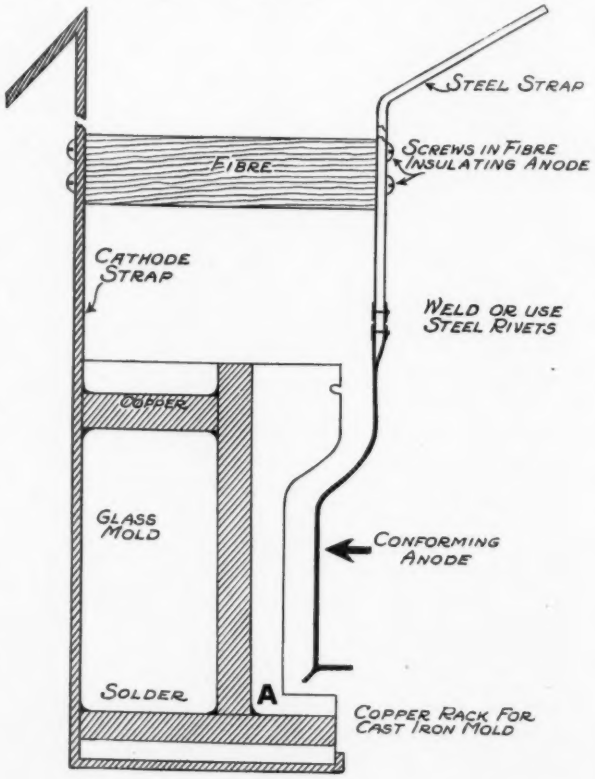

FIG. 5

If greater concentrations of chromic acid are used than that suggested above, the temperature and current density should be decreased to get best results.

Chromium solutions have a tendency to accumulate undesirable ingredients, such as iron and trivalent chromium. Small quantities of these are harmless, some even claiming that they improve the solution. However, when a sufficient quantity of either accumulates, the resistance of the bath is

increased so that greater voltages and current densities must be used, and may even reach the stage where it is impossible to plate at any current density available.

By using a lead lined tank, and lead anodes, the iron and trivalent chromium may be kept quite low. Should a greater accumulation of iron be found than desired, little can be done to remedy the condition. Boiling with aluminum or chromic oxides has been suggested, but neither are satisfactory. If the trivalent chromium accumulates until it gives trouble, it may be somewhat eliminated by operating the bath with several sheets of steel as cathodes, using a very large lead anode surface, and high current densities at the cathode. A better method is the use of a porous cup or cell, which is filled with a solution of chromic acid, and immersed in the bath with a sheet of steel or lead functioning as cathode within the cup. The trivalent chromium is collected in the cup and discarded after running for about 24 hours or more.

Complex sulphates may accumulate when trivalent chromium is present in large quantities. These may cause poor throwing power and other adverse conditions in the bath. Elimination of this may be accomplished somewhat by the addition of a paste of Vienna lime in small quantities, until the condition is somewhat remedied.

Table III is given from the literature on the causes and remedies of poor plating.

Table III

Defect of Deposit	Cause	Remedy
Insufficient coverage	Low current density.	Increase same.
" "	Anodes too far.	Bring closer.
" "	High trivalent chromium.	See second preceding paragraph.
" "	High temperature.	Cool bath.
" "	Pieces too close.	Obvious.
" "	Rack or holder shields too much.	Redesign same.
" "	Poor contact.	Examine anode and cathode connections.
" "	Anodes not working.	Scrape anodes clean of scale.
Thin, uneven, blackish, with no chromium in middle.	Low sulphate.	Add more.
Bright at edges, no chromium in middle.	High sulphate.	Add chromic acid, lime, barium chromate or hydroxide.
Deposit cracking away easily at edges, etc.	Sulphate complexes formed.	Add lime after all else fails, and filter. Add sulphate and more lime.
Burnt edges.	Low temperature. High current density.	Add sulphate if necessary.
Stains in deposit, and ghosts in plate.	Cleaning.	Use stronger acid for final dip.
Fine cracks.	Heavy deposit, sulphate complexes formed.	Reduce time and current density. Add lime.
Brown stains.	Low sulphate.	Add more.

Technique

In the plating of glass molds which contain depressions of various types, it will be found that through positioning of the work, complete coverage of the mold by the plating solution can be obtained if proper conditions are observed. These conditions have been included in the general descriptions given above. However, coverage of the mold is not all that is to be desired. It is usually necessary to have a uniform thickness over the entire surface of the mold. It will be found that at the best the throwing power of the solution may serve to cover concave depressions only slightly, while the protruding parts may receive very heavy deposits. To get a uniform deposit is usually necessary to make use of a conforming anode, illustrated in the cross-section Fig. 5. This anode is made of perforated hardened lead (6 per cent antimonial), or perforated sheet steel which may be lead coated. The anode should be made to conform as much as possible to the mold. Special precautions should be taken at corners of the mold where a sharp angle may cause poor deposition of chromium. If a sharp angle is present as at A, Fig. 5, it will be advisable to weld, burn or solder a projecting ridge of solid metal at this part of the anode. This enables the proper current density to be reached at the sharp angle. A ridge of this type is illustrated at the lower corner of the anode.

If the mold is of cast iron, it is advisable to use as much copper as possible in contact with the outer surface of the mold. If it is not possible or feasible to use a sort of copper form to hold the mold, as illustrated by the parts shown as copper in Fig. 5, copper wire may be wound around whereever possible; such as around projections, etc.

The conforming anode must be tied rigidly to the cathode by means of hard rubber or fibre insulating blocks. The anode must be connected by welding or soldering, to a strap of steel 1/16 inch thick by ½ inch wide or better. This strap must project sufficiently above the solution so that a flexible copper cable leading from the anode rods can be thereto attached by means of a clamp. The copper holder attached to the mold must have a copper strip 1/8 inch thick by ¾ inch wide or better, with the requisite hook at its upper end to make connection with the cathode rod of the tank. The cathode and anode rods of the tank, and the bus bars leading from the generator should be of sufficient size to carry the large currents necessary, without excessive heating. This is true of all conductors used in the tank.

After getting the proper holder and anode for the mold, the latter should be thoroughly washed free from all greases and oils. This is especially true of the gas vents. Soaking in gasoline or similar solvent for a few minutes, will probably suffice in most cases to remove or soften the greases or oils present. It should be borne in mind that any grease or compounds present on any part of the mold may spread during deposition to the plating surface and ruin the deposit.

The plating surface should be scrubbed with steel wool and pumice after the preliminary gas cleaning. Any regular alkaline cleaner wash may follow. The anode may now be put in place. A mild hydrochloric acid dip should be used to neutralize any alkali in the pores of the mold. This should be followed by good rinsing in clean running water. The mold is then hung in the plating tank which should be connected so that the current can be reversed on the work for a final cleaning operation. With the mold functioning as the anode, the current should be applied, using about one-half to two-thirds that required for regular plating. The cleaning time should only be about 15 to 20 seconds, after

which the current is reversed for plating. It should be raised to the value required slowly, and then permitted to remain unchanged during the plating period. If it is desired to examine the plate after a period of deposition, the mold may be removed and a rapid examination made. Before applying the current again, the mold should be permitted to remain in the tank for at least one minute to attain the tank temperature. Then the current should be raised slowly as before.

In the case of rolls, very much the same procedure should be followed. The rollers should be rotated a quarter turn about every fifteen minutes in order to obtain a uniform deposit. The ends of the rollers should be protected by bleeders to prevent excessive piling up of the metal.

All objects tend to plate heaviest at their ends, especially at the lower extremities. In the case of molds, if a projection is encountered which tends to accumulate too much metal, or burn, it should be protected by a bleeder. A piece of copper wire is attached to part of the mold or holder, and bent so as to approach the projection. This serves as a bleeder and will deflect the excessive current.

In concluding it will be well to summarize the conditions which must be observed to obtain satisfactory deposition of chromium on molds and rollers.

Physical

1. Proper size of generator to deliver the desired current.
2. Proper size bus bars to deliver the current to the tank without overheating.
3. Proper tank, preferably of all welded steel construction, lead or glass lined.
4. Proper size tank bus bars of copper.
5. Proper ventilating equipment.
6. Proper heating and cooling equipment, preferably steam with thermostatic control.
7. Proper holders for work.
8. Proper conforming anodes.

Chemical

9. The solution should always have a ratio of chromic acid to sulphate of 100 to 1, respectively. Chemical control is desirable, but a machine is now available which permits very rapid sulphate analysis, saving much time in routine control. A bent cathode test for sulphate determination is described by Pinner and Baker in the *Transactions, American Electrochemical Society* of May 30, 1929.
10. Proper cleaning methods.

The following are the most important items to observe in chromium plating:

1. Temperature.
2. Current density.
3. Cleaning.
4. Racking.

Practically all the important points and details of operation have been included in this article. By observation of those items especially emphasized, there will be few rejections. Chromium plating requires close scientific control and the process should be in the hands of the plant chemical engineer.

The Permeability of Glass
*to ultraviolet light**

by GOTTFRIED ROSE
Dipl. Engr., Altenfeld (Thuringia)

(Continued from the September, 1929, issue)

In the summary of his work, H. Heinrichs also emphasizes the fact that even in the glasses that appear to be blue, the equilibrium between FeO and Fe_2O_3 should be displaced strongly in favor of the divalent oxide, and that complete reduction of the iron is not obtained here. Rather, it is not impossible for pure ferrous oxide glasses to be colorless, as in minerals.

The glasses studied by Heinrichs and Heumann had an iron content of about 1%, and these investigators were able to use the ordinary methods of determining iron for the determination of FeO in the presence of Fe_2O_3. But the well-known methods of determination fail with the much smaller amounts of iron in the ultraviolet glasses; they no longer give sufficiently accurate results. For this reason I had to abandon the determination of divalent and trivalent iron in the presence of each other in ultraviolet glass, and at first I was satisfied to determine the total iron.

If the total iron content is to be determined gravimetrically, difficulties are caused by the simultaneous presence of titanium, tin and zinc in the glass, and also by the iron contained in the hydrochloric and nitric acids. For this reason, I preferred the colorimetric method.

The thiocyanate method did not always give concordant results, even after the addition of boric acid as recommended by Hackl[16]. For example, in the determination of the iron content of vitaglass, I obtained the following values:

0.0014% 0.006% 0.0085% Fe_2O_3.

The determination of iron using dimethylglyoxime, given by Tschugaoff and Orelkin, gave more reliable results. With a sufficiently large addition of hydrazine sulphate, there was no noticeable fading of the red color even after some days, and the results agreed to 0.0004% with an iron content of 0.24 mg. Example:

S_6	I. Decomposition	0.0097% Fe_2O_3 (1st observation)
		0.0099% Fe_2O_3 (2nd observation)
	II. Decomposition	0.0100% Fe_2O_3 (1st observation)
		0.0101% Fe_2O_3 (2nd observation)
S_1	I. Decomposition	0.0601% Fe_2O_3 (1st observation)
		0.0601% Fe_2O_3 (2nd observation)
		0.0600% Fe_2O_3 (3rd observation)
	II. Decomposition	0.0600% Fe_2O_3 (1st observation)
		0.0600% Fe_2O_3 (2nd observation)

*Translation from *Sprechsaal*, 1929, v. 62, p. 352-4, 375-7.
[16]Hackl, Zeitschrift für analytische Chemie, v. 66, p. 401, to 430.

The observations or colorimetric comparisons were made in a Leitz colorimeter, which permitted the exact reading of the layer thickness to 1/10 mm. With an Fe_2O_3 content of 2.59 mg Fe_2O_3 in a 2.9958 g sample, a difference of 1/10 in the reading gave a difference of 0.000006 g Fe_2O_3 (assuming the adjustment of the colorimeter at 40.0 and 40.1). In the 2.9958 g sample of glass powder, this means a percentage difference of 0.00002% Fe_2O_3. The greater difference between the individual observations and determinations which, as we saw above, increases to 20 times the possible accuracy, is due to the slight strength of color-sensitivity of the eye. In the July, 1928, issue of *Glastechnischen Berichte,* there are given iron determinations made by Starkie and Turner[17] in England. They also were made on glasses the permeability of which had been converted to a thickness of 2 mm. and gave:

TABLE 4

0.180% Fe_2O_3	permeable up to 317.5 $\mu\mu$
0.070% Fe_2O_3	permeable up to 298.5 $\mu\mu$
0.060% Fe_2O_3	permeable up to 297.5 $\mu\mu$
0.050% Fe_2O_3	permeable up to 296.0 $\mu\mu$
0.015% Fe_2O_3	permeable up to 274.0 $\mu\mu$
0.008% Fe_2O_3	permeable up to 266.0 $\mu\mu$
0.005% Fe_2O_3	permeable up to 260.0 $\mu\mu$

If the Fe_2O_3 values thus obtained are plotted on the abscissa and the permeability limits on the ordinates, we get

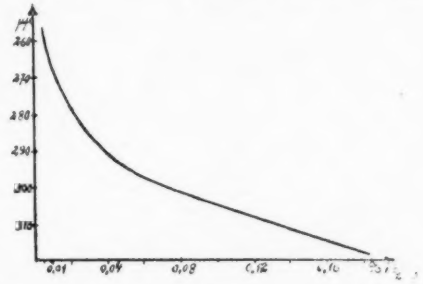

FIG. 5. The drop in ultraviolet permeability with increasing ferric oxide content. (The wave lengths show the lower permeability limits.)

a curve that would have to intersect the ordinate at about 220 $\mu\mu$, that is, a glass perfectly free from iron would be permeable up to about 220 $\mu\mu$ (figure 5).

The iron content found by me agrees perfectly with the values calculated from the curve although, as I shall show later, this need not be the case unconditionally. If the value of 0.010% Fe_2O_3 for S_6 would have to give a permeability of 269 $\mu\mu$ theoretically while the lowest limit measured by me is at 270 $\mu\mu$, this due to the fact that the next line in the mercury spectrum is at 265 $\mu\mu$ where, naturally, permeability can be observed no longer. Figure 6 shows the drop in permeability for ultraviolet light with increasing Fe_2O_3 content of the glass at a given wave length. I have selected for this the wave length of 297 $\mu\mu$ which is so important therapeutically. Here also, the curve is not a simple line, but is sharply bent.

As can be seen from the different shape of the permeability curves for the glasses tabulated in table 3b, [see page 221, September, 1929, issue] which were melted from the same raw material in addition to being made in the same pot, and therefore they had to have the the same total iron content, not only the total iron content of the glass, but the stage of oxidation of the iron also, determines the shape of the curve. As we saw, an exact determination of the ratios

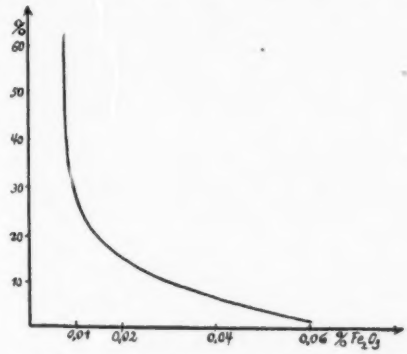

FIG. 6. The ultraviolet permeability of glass at 297 $\mu\mu$ with varying Fe_2O_3 content.

failed because of the failure of the methods of determining iron with such low iron content.

In order to study these ratios more closely, I took up the subject of aqueous iron solutions.

It was not expected from the very beginning that these same conditions would prevail in aqueous solutions as in the glasses containing iron, although the similarity in the color of natural iron silicates, to the iron compounds contained in glass as observed by Heinrichs, made this seem hopeful. The investigations that were made, have fully confirmed our hopes.

VI. THE PERMEABILITY OF AQUEOUS SOLUTIONS OF IRON SALTS TO ULTRAVIOLET LIGHT.

(*a*) *The permeability of aqueous solutions of divalent iron.*

The absorption curves of aqueous solutions of divalent iron were made using solutions of Mohr's salt. This was

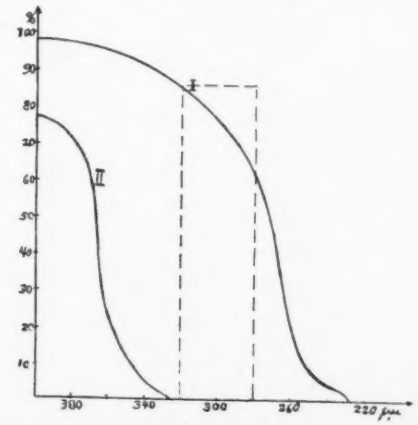

FIG. 7. Permeability curves of divalent iron (Mohr's salt). I. 1.114 g FeO/1. II. 11.14 g FeO/1. . . . region important therapeutically.

first titrated with a potassium permanganate solution of known liter, and was found to be completely undecomposed, corresponding to the formula:

$$(N\,H_4)_2\,SO_4.\,FeSO_4.\,6\,H_2O$$

With a 6.080 g sample of Mohr's salt in a liter, there was

[17] Glastechnische Berichte, v. 6, p. 200, No. 4.

obtained an FeO content of 1.114 g FeO in a liter. With a sample 10 times as large, 11.14 g FeO is found in the liter (curves I and II in figure 7).

It is characteristic of the absorption curves for divalent iron that at the higher wave lengths, they drop a little in the beginning, and then the drop starts suddenly and very steeply (in curve I from 290 $\mu\mu$ on).

Both curves (I and II) were made a few minutes after the preparation of the solution. The solution was slightly acidified with a few drops of concentrated sulphuric acid in

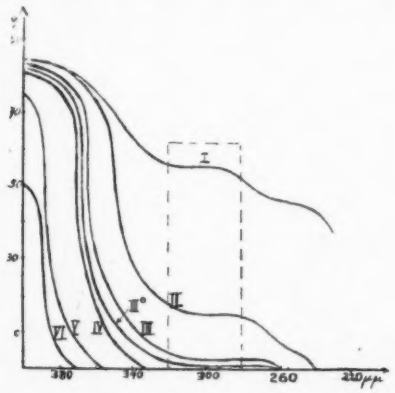

FIG. 8. Permeability of trivalent iron (ferric-ammonium sulphate).
I. 0.00532 g Fe_2O_3/1 II. 0.0130 g Fe_2O_3/1 III. 0.0260 g Fe_2O_3/1
III° 0.0290 g Fe_2O_3/1 IV. 0.0589 g Fe_2O_3/1 V. 0.1470 g Fe_2O_3/1
VI. 0.2940 g Fe_2O_3/1

order to prevent, as far as possible, decomposition during the time required for making the curve. The determinations were made in such a way that the solution in the top bulb holder was kept in a bulb 32 m long, which was closed in front and back by two quartz plates. Two quartz plates of the same thickness as in the top holder, were used in the lower holder.

(*b*) *The permeabilities of aqueous solutions of trivalent iron.*

The curves for trivalent iron were made in the same manner as for divalent iron. The same bulb as above was used for holding the solutions.

The solutions were made by dissolving ferric-ammonium sulphate in water. The salt was first analyzed for its iron content by the permanganate method (reduction with stannous chloride and oxidation with permanganate), then gravimetrically, and finally with the titanium chloride method. This salt corresponded to the formula:

$$(N\ H_4)_2\ SO_4.\ Fe_2\ (SO_4)_3.\ 24\ H_2O.$$

An 0.0321 g sample of ferric-ammonium sulphate in a liter corresponds to a ferric oxide content of 0.00532 g Fe_2O_3 in the liter (figure 8, curve I). The solutions were likewise acidified slightly in order to prevent the formation of $Fe(OH)_3$.

In their course, their shape, and also in the intensities of the absorption, the curves show essential differences as compared with the absorption curves for divalent iron.

First, the great difference in the intensity of the absorption is striking; it is more than 100 times the absorption of divalent iron. As regards the shape of the curves; we see first that the steepest drop starts even before the therapeutically important region with wave lengths from 320 $\mu\mu$ to 280 $\mu\mu$. Within this region, the curves are somewhat parallel to the abscissa, and gradually decrease to zero. Even in the bulging of the permeability curves thus caused, the curves for trivalent iron differ essentially and in a characteristic manner from those for divalent iron.

(*c*) *The ultraviolet permeability of ferrous and ferric salt mixtures.*

Another question was: What are the permeability curves of mixtures of divalent and trivalent iron salts? In order to test this, I made a solution which contained both 1.114 g of FeO (6.080 g of Mohr's salt) and 0.029 g Fe_2O_3 (0.1752 g ferric-ammonium sulphate) in a liter, and determined its ultraviolet permeability immediately after the preparation of the solution. Figure 9 shows the permeability curve thus obtained.

For purposes of comparison, the permeability curves for solutions of the unmixed salts were taken from figures 7 and 8. As the lines between the three curves show, the curve obtained actually represents the average of the other two curves; the slight deviations from the theoretically calculated curve at a few points are unimportant and due to errors that can not be entirely avoided in making the curves.

If the curve that is found lies entirely somewhat below the theoretical curve, this is due to a slight conversion of divalent iron into trivalent iron, which took place during the filling of

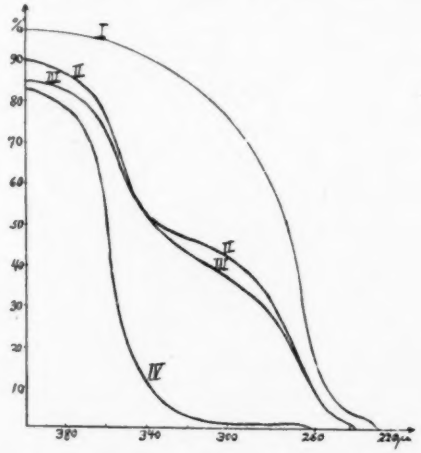

FIG. 9. Permeability of ferrous and ferric salt mixtures.
I. Curve for 1.114 g FeO/1. II. Curve calculated theoretically.
III. Curve actually observed. IV. Curve for 0.029 g Fe_2O_3/1.

the bulbs and, as we shall see later, during the drawing of the curve itself, due to the effect of the ultraviolet radiation, accelerating the transformation.

In any case, the curve for the mixture gives us a clear picture, showing how one can obtain a rather accurate indication of the divalent and trivalent iron present by the spectrographic investigation of a solution with a known total iron content.

The Hackl method of determining iron also gives exact values in the aqueous solution that was just studied. But with a low iron content in our ultraviolet glasses, as we

shall see, the spectrographic method gives an indication of the divalent and trivalent iron content.

VII. The Ultraviolet-permeability of Commercial Glass and Test Melts.

After we have considered the curves for pure ferrous and pure ferric iron, if we first consider the curves for commercial ultraviolet glasses and then those for test melts, we find a great similarity in the shape of the curves. The

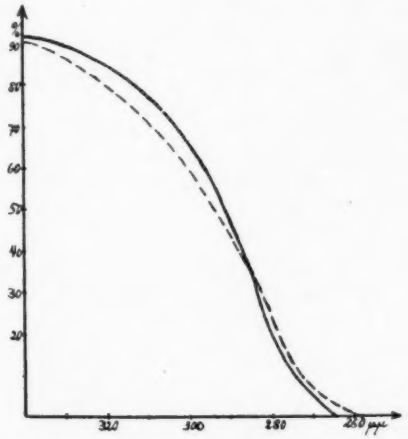

FIG. 10. Ultraviolet permeability of commercial glasses. . . . Vita glass. . . . Brevos glass.

commercial glasses show the curve shape that bulges far outward, whose drop in the region between 300 $\mu\mu$ and 280 $\mu\mu$ is somewhat more than in the ferrous salt curves, which reached the abscissa later. The former case can also be explained. Taken as a whole the shape of the curves for commercial glasses (figures 10 and 11) is very similar to the drop in the curves for the ferrous salt. But the similarity to the

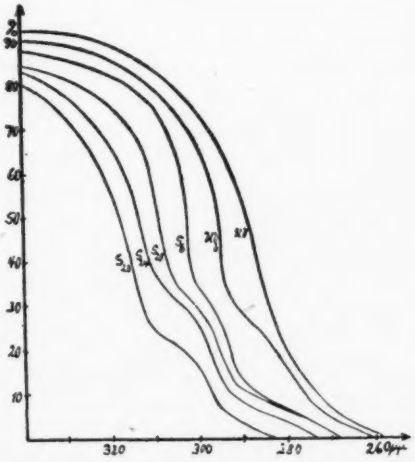

FIG. 11. The ultraviolet permeability of some test melts compared with commercial ultraviolet glasses.

shape of the curve for the salt mixture of divalent and trivalent iron is even greater when considering the curves for the test melts S_{23}, S_{24}, and S_{25}.

These melts were made from the same raw materials, but differ only in their reducing-agent content. The total iron content is the same, and only the ratio of divalent and trivalent iron must be assumed to be different. We see that melt S_{23}, made without reducing agents, lies considerably below melts S_{24} and S_{25} made with reducing agents, particularly in the region of 294 $\mu\mu$, 297 $\mu\mu$ and 302 $\mu\mu$, which is important therapeutically. From this we see that the iron values given in figure 5 in relation to the permeability limits are valid only if we are dealing with glasses that have been melted under the same conditions and with the same amount of reducing agent.

From the shape of the curves for S_{23}, S_{24}, S_{25} and S_6 and those for the ultraviolet glasses, we also see how the bulges, caused by trivalent iron (312 $\mu\mu$, 294 $\mu\mu$) are gradually displaced upward and also to the right, as the curves become more and more similar to the shape of the curve for ultraviolet glass. In the glass UVb, the bend can still be seen for the wave lengths 297 $\mu\mu$ and 294 $\mu\mu$.

The action of carbon as a reducing agent was also tested. As a matter of fact, there is found to be a slight increase in the ultraviolet permeability with increasing carbon content (S_{13} and S_{14}) but the effect of carbon is very slight and with a still higher addition of carbon (0.25%) the glass has a yellow tinge that is seen in the glass that is intentionally colored yellow, using graphite or tartar emetic.

As its volatility would lead us to expect, sodium chloride has no reducing action in glass melts (S_9, S_{10}, S_{11}). If the ultraviolet permeability of these melts are below the glass S_{23} which has no addition, it is because the Wittenberg sand that was used has a higher iron content.

On the other hand, the oxygen content of the fuel gas naturally plays an important part. This oxygen content can not always be kept constant in practice. This might explain the fluctuations in glasses melted with the same total iron content, such as S_6 and S_7 and also S_9, S_{10}, S_{11}, as no other explanation can be found.

(To be continued)

Ultraviolet Solar Radiation

In connection with the bureau's investigation of the properties of special window glasses and glass substitutes for transmitting ultraviolet solar radiation of wave lengths less than 310 millimicrons, measurements were made at two elevations (7,250 and 10,500 feet) at Flagstaff, Ariz., to determine the amount of incoming ultraviolet radiation at these higher elevations as compared with a station practically at sea level, Washington. An interesting result is the observation that, while the spectral quality of the ultraviolet at the 10,500 feet station is appreciably different (being richer in short-wave length ultraviolet) from that at the 7,250 feet elevation, the total amount of ultraviolet, of wave lengths less than 310 millimicrons, for unit air mass, is practically the same at these two stations. This is the result of the increased scattering of ultraviolet radiation at the lower (7,250 feet) elevation.

To Celebrate Wedgwood Bicentenary

The Ceramic Society of England has fixed the date of the Wedgwood Bicentenary as the week of May 18, 1930. Plans are being made for this celebration in honor of Josiah Wedgwood, the famous potter. Wedgwood at one period had the original of the famous blue glass Portland Vase, found in a marble sarcophagus near Rome in the 17th Century, in his possession for over a year and made a copy of it in pottery, which attracted wide attention.

The American Ceramic Society is cooperating with the Ceramic Society in working up a program for this celebration and a large attendance from all parts of the world of persons interested in caramics is expected.

Fuel Oil for Industrial Furnaces[1]

by LEOD D. BECKER
President, Electrol, Inc.

Oil is strongly entrenched as an industrial furnace fuel. No more so, of course, than coal, or gas, or electricity—and in fact, probably less so when considered in relation to its suitability for this work. Oil is admirably adapted to intricate phases of industrial furnace design, and if other fuels are, in comparison to their general suitability and cost, more extensively used, it is probably due to more aggressive merchandising on the part of interests representing either the equipment using those fuels, or those interested in increasing their output.

Although the total consumption of coal in the steel industry has been decreasing, even though a greater quantity of iron and steel has been produced, during this same period fuel oil has actually shown an upward trend. In fact, this gradual upward trend has been taking place for the past twenty years, apparently unaffected by the peaks and valleys caused by war, coal strikes or general business conditions.

Improved furnace design is in a large measure responsible for the increased output of product with less fuel, which applies to all industries. An efficient burner, no matter what fuel is used, will not give the desired result *if the furnace does not bring* the heat in contact with the furnace charge at the proper time, for the proper duration of time, and at the right place.

There have been beneficial changes in the firing of all industrial fuels, and through improved burner design, this is especially true of fuel oil. I recently spent an afternoon with a manufacturer of industrial burners and witnessed a demonstration of his latest equipment. One of the burners that impressed me most had three air controls: two over the primary and one over the secondary air. The burner was first adjusted to produce a long, intense flame, which was nothing unusual, to be sure. But then this same burner was readjusted and I next saw a wide, bushy, lazy flame which reminded me of the flame produced by the conventional industrial high pressure mechanical burner. And this short, wide flame was burning with the same fuel consumption as the long flame; that is, the air control was solely responsible for the change in flame shape. That is one example of what I mean by improved oil burner design.

I might go on to cite other types of furnaces in which oil is doing a good job but to do so might imply that oil is superior to all other fuels in all types of furnaces. Such is not the case. Rather, I firmly believe that for industrial furnaces, oil fills an economic gap between electricity and gas on the one hand, and solid fuel on the other. The destiny of each fuel is shaped by the economic factors and manufacturing problems existing in each locality and in each individual plant. The question is not: "Which fuel is best, merely as a fuel?" but "How can heat be generated and applied to the product with the greatest ease of fuel transportation, with a minimum of labor, with a low manufacturing cost, but without sacrifice of product quality?" In one plant on a specific process, the answer may be gas, in another oil, and in a third it may be coal.

Oil is an important industrial-furnace fuel because it has so many of the advantages obtainable with electricity or manufactured gas, but costs less.

Unintelligent use of fuel oil has been responsible for much waste and inefficiency in oil burning equipment. Many plant owners have switched from other fuels to oil without due regard to furnace and installation changes necessary to obtain the utmost efficiency from liquid fuel. They burn oil today merely because it is the cheapest fuel. Tomorrow they may be burning coal again. So many owners of coal-fired furnaces have attempted to reduce their manufacturing costs by installing a makeshift oil burning system in order to take advantage of prevailing fuel costs. Then when the standard of quality of the finished product has been affected, they have blamed the oil and the oil burners. If those plant owners would study their individual conditions and then decide on one particular fuel, and make all necessary furnace and manufacturing changes necessary for that particular fuel, they would obtain maximum results over a long period. If a particular furnace is designed to burn one fuel efficiently, it is more economical to continue with that fuel in the face of slightly increased prices, than to attempt to burn a cheaper fuel in a furnace designed for an entirely different fuel.

The wider use of fuel oil in industrial furnaces cannot depend on such makeshift installations. Owners must be encouraged to anticipate the manifold requirements of the fuel which is most suitable for their plant. If they want to burn a No. 6 fuel oil they must install suitable preheaters to condition the oil, as well as the straining equipment required for this heavier oil. But no matter which oil is used, the furnace must be capable of extracting the calorific value of the fuel and utilizing the heat thus generated in the best possible way, which is determined only by individual conditions.

The unwillingness on the part of a plant owner to make a thorough rearrangement of furnace and manufacturing equipment when changing from another fuel to oil, is frequently because he has lacked reassurance that the change would be a permanent one. In many cases the change has not been permanent due to unsatisfactory results with makeshift equipment or, more likely, because of superior propaganda from competitive fuel enthusiasts. No manufacturer of furnaces and no group of fuel interests have adequately presented the comparative economic and engineering advantage of oil, as they have with gas and electrical equipment.

Oil has been too much of a mystery fuel for plant owners to experiment with. They have had to find out for themselves its advantages or disadvantages in their own plants,

[1]Abstracts from a paper presented at the Third National Fuels Meeting of the A. S. M. E., Fuels Division, Philadelphia, Pa., October 7-10, 1929. The complete paper will appear in the Fuels and Steam Power Section of the A. S. M. E. Transactions.

often to their sorrow. There has been too little general information available concerning its limitations and its advantages. Many times oil supporters themselves, in the anxiety to make a sale of burner or furnace equipment, have made reckless claims for oil. Only when everyone realizes that the advantages in favor of oil, or any other fuel, are dependent on many factors beyond the control of the fuel itself, will real progress be made in the intelligent selection of the fuel for a given process in industrial heating.

All of which means that there is a greater need today for the dissemination among manufacturers of sound engineering information as to the proper application of oil, than for high-pressure sales of low cost equipment that may or may not achieve the desired results. The lack of unified effort to bring such information before the industrial furnace industry as a whole has hindered, more than anything else, the more rapid progress of oil. Too much emphasis has been laid on oil burner design rather than on coördination of combustion and the generated heat with the work to be accomplished or, in other words, the finished product.

Now regarding the economic problem. I am not here to discuss the extent of our oil resources, nor do I think any one needs reassurance that oil supplies will exist for several decades. Refining methods will continue to change and improve, and may affect the grades and prices of fuel oil, but the supply will be more than ample for all those uses in which oil has inherent and superior value. The oil companies themselves have given little or no assistance to the industrial users of fuel oil, nor to furnace designers, in the past. An illustration is the case of an eastern manufacturer who decided to look into the possibilities of fuel oil for his furnaces. Estimates were secured on the cost of changing the plant to efficient oil burning, and for suitable tankage to be provided to accommodate barge deliveries of oil, as the plant is on tidewater. On consulting several oil companies, however, it was found that only short time contracts could be entered into for fuel deliveries, with no guarantees of stable fuel oil prices. So indifferent were the oil companies to the possible oil business of this plant that the owner became discouraged and abandoned his plan to use oil.

There has also been a lack of coöperation among burner manufacturers themselves. There is no organization representative of the industrial oil burner manufacturers to cope with common problems and promote their interests among potential oil consumers. In contrast to this, other fuel industries have been well organized for some time, so that effective propaganda has been responsible for considerable gains in the use of such fuels.

These conditions are rapidly changing, however. Out of the mass of burner and furnace manufacturers has arisen a class who are competent and willing to demonstrate the advantages of fuel oil in many process industries. Companies with financial backing and foresight enough sell oil burners not merely as oil burners, but as part of a coördinated plan to effect savings either in time, in quality, or in cost.

I am covering many of the merchandising phases of industrial oil burning because it is mainly a merchandising problem. Engineering methods for applying oil to industrial furnaces have reached a high stage of perfection, proper installation facilities and oil supplies are available, and furnace design problems are recognized. The only thing that remains is to tell the industrial world about oil. Look at the domestic oil burner field, and how far organized effort has carried them. Oil companies are now supplying oil under specifications originated by the domestic and commercial burner manufacturers—not any oil that the refiner may want to unload. This directly affects the industrial furnace market because those same oils are now available to all industries. While oil uniformity may not be a serious consideration in industrial furnace work, it does permit of better results in the furnace, by reducing the adjustments necessary every time a new load of oil is delivered.

New Borate Mineral Finding Commercial Use

Miners, prospectors, and mineralogists have so thoroughly searched every nook and cranny of the earth's upper crust that nowadays new minerals are seldom found, or where they are discovered, are apt to be rare, and to exist in small quantities of no particular commercial importance. Nevertheless, a new boron-containing mineral, discovered within the last five years, has been found in such quantities as to render its commercial exploitation possible, according to the Pacific Experiment Station of the United States Bureau of Mines, Department of Commerce.

The new mineral, which has been variously called Razorite or Kernite, is found in the Mojave desert of California, at depths some 600 to 800 feet below the present surface of the ground. The pure mineral is colorless, transparent, and occurs in lamellar or columnar form. It contains the oxide of boron and of sodium, together with some water, and in places is of high purity, but differs markedly in physical properties from the ordinary borax of commerce. Its constitution has been of great interest to the chemist, who has hitherto known only the normal crystallized sodium borate, which contains ten molecular proportions of water to one of borate, and the octahedral sodium borate, with five molecular proportions of water. Both of these forms are readily soluble in water, the former being the sort found in nature as the result of the natural evaporation of alkaline lakes. The octahedral form is unstable with respect to water at ordinary temperatures, and is not found in nature, but can be prepared in the laboratory by crystallization above 142° Fahrenheit. Chemists have not succeeded in preparing the new mineral form in the laboratory, for although it contains from 3½ to 4 molecular proportions of water, it is dissolved in water only with considerable difficulty. It seems probable that the material is a product of volcanic activity.

One of the larger uses for the borate is in the manufacture of certain special glass, and for glazes of sanitary ware.

Japan's Soda Ash Industry Subsidized

Continued agitation for the greater development of the soda ash industry in Japan resulted in a subsidy of 213,000 yen being granted to this industry for the current year. (1 yen in 1928 = $0.464 United States currency). The progress of this industry in Japan has been retarded by the uncertain cost of the raw material (common salt) which is obtained from China. Fluctuations in the value of the domestic output per ton are said to be due to variations in salt prices. The local production and value per ton in recent years were as follows: 1924—2,206 short tons, valued at 329 yen per ton; 1925—12,304 tons, 90 yen per ton; 1926—19,089 tons, 45 yen per ton; 1927—25,496 tons, 175 yen per ton.

Imports of soda ash are composed largely of the natural soda from Lake Magadi, supplied by the British and natural soda (Trona) from the United States. During recent years the imports of natural sodas and soda ash combined were as follows: 1924—131,005 short tons, 1925—143,314, 1926—40,297, 1927—110,477, 1928—86,513. (*Assistant Trade Commissioner H B. Titus, Tokyo*) *in World Trade Notes.*

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We Heartily Wish All of Our Readers a Merry Christmas and a Happy New Year

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Passing of the National Window Glass Workers

The October issue of the *Monthly Labor Review* of the U. S. Bureau of Labor Statistics, Washington, D. C., contains an interesting 16-page history of the beginning and progress of labor unions composed of glass blowers, gatherers, flatteners, and cutters n the United States. Before 1880 window glass workers were organized into scattered local unions, the different trades having separate organizations. In 1879 the various groups of blowers and gatherers combined as Local Assembly No. 300, Knights of Labor. The cutters and flatteners joined this organization in 1880. The slogan "Never Surrender" was adopted. For the last 40 years Local Assembly No. 300 and other organizations of window glass workers which superseded it in the hand manufacturing field maintained the attitude suggested by that motto so successfully that they not only held complete control of the industry economically but to a large extent commercially through agreement and cooperation with the manufacturers. A few quotations from the Review follow:

"Window-glass workers were highly skilled craftsmen, holding firmly to the old guild standards of skill and nationalism and to the doctrine of handing the trade on from father to son. By 1900 the organized window-glass workers held a position of power and prestige which remains unique in labor history."

"But the craft which 'never surrendered' in economic situations went down to defeat in the face of the mechanical progress of the twentieth century, and the organization of hand workers passed out of existence in 1928, still a skilled craft union which for years had refused to make any concessions to the machines which killed the handicraft. The organizations which grew up within the machine glass plants as the result of that attitude on the part of the hand craftsmen now represent organized labor in the windowglass industry."

The story covers the disruption of Local Assembly No. 300, the organization of the Window Glass Workers Association of America and the various changes in the labor union situation which have occurred since that period. The effect of the introduction of machinery is described and the rise and decline of various associations outlined.

"By 1922 the hand industry was feeling the encroachment of the sheet-drawing machine plants in two ways—in the loss of workmen, who were going into the machine plants, and in the closing down of many hand plants which could no longer meet the machine competition."

"The official records of the National Window Glass Workers for the year 1924 show a succession of events and conditions which proved, in the light of later developments, to be hurrying the organization to certain death."

"By that time (1924) the treasury had been practically depleted because of a diversion of funds to the National Window Glass Manufacturing Co. The union decided to enter the hand manufacturing business, and for that purpose leased a plant in Huntington, W. Va., which commenced operations in March, 1924."

"The National Window Glass Co. operated for three years, producing glass which it sold at less than cost, and never

made expenses. It closed in the spring of 1927 with a net loss of $84,000."

"The sheet-drawing machine interests advertised their product extensively and apparently so effectively that not only the hand glass but the cylinder machine product began to feel it."

"Before long the Libbey-Owens sheet drawing enterprise met new competition from another quarter, the introduction into this country of the Belgian sheet process on the Fourcault machine, the expiration of the patents on which permitted its installation here."

"After an extensive survey of the industry in 1927 the president of the National Window Glass Workers reported that in his observation and opinion the cylinder machine plants will be compelled to adopt a sheet drawn method of production within a comparatively short time if they are to remain in the business."

Declaring the situation hopeless the Executive Board of the union met on June 29 and 30, 1928, and formally disbanded. What became of many of the jobless hand workers is told in the closing paragraphs of the story which is a valuable contribution to the history of the industry.

Judge Schoonmaker's Full Decision in Laminated Glass Patent Infringement Case

AN opinion of decided importance to the plate and flat glass trades, also of particular interest to the automobile manufacturers of this country and which will attract considerable attention abroad, was filed on November 15 in the Federal Court at Pittsburgh, Pa., by Judge F. P. Schoonmaker.

The case was that of the Triplex Safety Glass Company of North America, whose main office is at Clifton, N. J., against the Pittsburgh Safety Glass Company, of Pittsburgh, Pa. (now known as the Duplate Corporation). It involved the Benedictus patent[1] No. 1,182,739[1], issued May 9, 1916, which is a patent on laminated or non-shatterable glass, now being used extensively in windshields, doors and windows of automobiles.

An accounting of profits and damages was asked for by the plaintiff and also an injunction to restrain the defendant from further use of the invention covered by the patent which is the plaintiff's property.

The defendant company lost the decision, the court holding that the patent is valid and was infringed by the Pittsburgh Safety Glass Company.

The litigation was started on December 31, 1928, with the filing of a complaint by representatives of the Triplex organization. A hearing was held on September 3, and more than ten weeks later the decision was handed down.

There has been considerable discussion of the case among those interested in the glass industry as important questions were involved as to the exact nature of the product being manufactured by the defendant corporation.

Both the Triplex and the Pittsburgh Safety Glass companies were represented by some of the best legal talent. The Clifton company's case was in charge of William B. Greeley of Redding, Greeley, O'Shea & Campbell, New York, with Drury W. Cooper as associate counsel. The defense was in the hands of Marshall A. Christy, a noted patent attorney, of Christy & Christy, Pittsburgh.

The only claim involved was a product claim. The infringement of the process claim was not charged.

Claim 12 in the Benedictus patent, in suit, reads as follows:

> "As a new article of manufacture, a sheet of celluloid faced on both sides and in the order named by sheets of gelatin and glass, all rigidly and autogenously united together, and the gelatin being substantially free from contained moisture, as described."

In his opinion, Judge Schoonmaker held:

"The patent relates to non-shatterable glass. In the prior art the strengthening of glass by inserting a sheet of celluloid between the sheets of glass was known, and the use of balsam for causing the sheets of glass and celluloid to adhere together, was disclosed in the prior patent of Wood. The fact that the gelatin might be used as an adhesive was also known to the prior art.

"The plaintiff contends that Benedictus brought to the art the use of gelatin substantially free from contained moisture as an adhesive element in causing the sheets of celluloid and glass to adhere together.

"We find this to be so. The product resulting from the use of this new especially prepared adhesive, therefore brought to the art a new article of manufacture. Is it then a product for which a patent should issue? That it was a useful invention is evidenced by the fact that it has been largely used in the automobile trade for automobile windshield and windows, and in such use has a tendency to reduce the danger of personal injuries by collision of automobiles due to flying glass. It appears, in fact, that sixty per cent of personal injuries in automobiles is due to flying glass. The plaintiff has developed a large trade; and this glass has come into general use.

The Ford Motor Company has taken a license under the Benedictus patent.

"We have no hesitation in concluding that the patent is valid, that there was a real invention in bringing to the art the product made by adhesion of celluloid and glass with the use of gelatin that is substantially free from contained moisture. It was thoroughly demonstrated that using wet gelatin or sticky gelatin for the purpose of cementing together the sheets of glass and celluloid resulted in a product which was streaked and cloudy, took away from the clear visibility that was produced by the use of gelatin from which the moisture had been substantially subtracted. The use of this dehydrated gelatin as a cement was not a mere improvement in the crowded art. Benedictus was the first to bring to the art the use of gelatinous cement which would provide unclouded glass. We, therefore, hold his claim 12 valid, and construe it broadly as bringing to the art a new product, i.e., laminated glass, in which the constituent elements of celluloid and glass have been cemented together with a gelatin which has been substantially dehydrated.

"We need next to determine whether or not the defendant by its product has infringed the patent. We find from the evidence that the defendant in its product uses glass and celluloid cemented together by a thin film of gelatin in substantially the same manner as that disclosed by the Benedictus patent. In other words, the defendant uses for cement a gelatin from which the moisture has been substantially extracted by heat. That was the main disclosure of the Benedictus patent, i.e., the fact that gelatin which is practically dry to sight and to touch could be used under heat and pressure so as to cause sheets of glass and celluloid to adhere and thus produce a strengthened glass with no impairment of transparency. That was the real invention of Benedictus.

"The defendant has incorporated in its product that very cement. There is evidence that the moisture content of the gelatin used by the defendant is much greater than the gelatin used by the plaintiff's process, and that the defendant in its process does not use alcohol to further the dehydration of the gelatin. But the main element is there, gelatin with the moisture sufficiently extracted so as to cause the sheets of celluloid and glass to adhere to one another with no impairment of transparency. That is the product of both processes used by the plaintiff and the defendant.

"The defendant has sought to construe the claim in suit so that it can only be infringed by the exact process described in the patent, contending that it is a narrow claim and must be limited to exact processes disclosed by the patent, and citing as authority for that, the opinion of the Circuit Court of this circuit in the case of Downes vs. Teter-Heany Development Co. 150 Fed. 122. We do not believe that that case is applicable to the facts of the instant

[1]Reviewed on page 3, January, 1929 issue, The GLASS INDUSTRY.

case, because the product is sufficiently described in Claim 12, which may therefore be sustained independently of the process or the process claims. Holland Furn. Co. vs. Parkins Glue Co. 277 U. S. 245 (254). Here we have a valid patent for a product composed of sheets of glass and sheets of celluloid cemented together with gelatin substantially free from contained moisture.

"The manner of subtracting the moisture from these cementing elements is not important. The fact that the defendant may not use the alcohol in its process does not mean that it does not use gelatin from which the moisture has been substantially extracted.

"The defendant has offered evidence that the cementing gelatin which it uses contains as much as sixty or seventy per cent of contained moisture. We cannot so hold. From the evidence we find that the cementing gelatin used by the defendant in its product is practically of the same moisture content as that used by the plaintiff in its product under the patent.

"We, therefore, find in this whole case that the patent in suit is valid and has been infringed. The plaintiff is entitled to the relief prayed for in its bill of complaint. Let a decree be submitted accordingly."

Owens-Illinois Alleges Infringement of Soubier Patent

The Bill of Complaint filed November 15, 1929, by the Owens-Illinois Glass Company in the Federal District court at Toledo, Ohio, against Frank O'Neill and the O'Neill Machine Company, alleging infringement of United States patent No. 1,705,341 is given below.

Bill of Complaint

TO THE HONORABLE THE JUDGES OF THE UNITED STATES DISTRICT COURT IN AND FOR THE NORTHERN DISTRICT OF OHIO, WESTERN DIVISION:

Owens-Illinois Glass Company, plaintiff, by this its bill of complaint, complains and says:

1. That plaintiff, Owens-Illinois Glass Company, is a corporation organized and existing under and by virtue of the laws of the State of Ohio and has its principal place of business at Toledo, Ohio.

2. That plaintiff is informed and believes and therefore avers the fact to be that the defendant Frank O'Neill is a citizen of the United States residing at Toledo, Ohio, within said Northern District of Ohio, Western Division, and that the defendant The O'Neill Machine Company is a corporation of Ohio and has a regular and established place of business at Toledo, Ohio, within said Northern District of Ohio, Western Division, where the infringing acts hereinafter complained of have been and are being committed.

3. That this is a suit in equity arising under the patent laws of the United States, which is the foundation of the jurisdiction of the Court.

4. That on or before August 27, 1923, Leonard D. Soubier, a citizen of the United States and resident of Toledo, Ohio, was within the meaning of the Statutes of the United States then in force, the original, first and sole inventor of certain new and useful improvements in Glass Blowing Machine and on the 27th day of August, 1923, made application in due form of law to the Commissioner of Patents for the grant of Letters Patent therefor, which invention had not been used or known in this country and not patented or described in any printed publication in this or any foreign country before his said invention thereof, or more than two years prior to his said application for Letters Patent, and not in public use or on sale in this country for more than two years prior to his said application, and for which invention no application for Letters Patent was filed by him or his legal representatives or assigns in any foreign country more than twelve months prior to his said application for Letters Patent in the United States, and which has not been abandoned; and after due proceedings by the Commissioner of Patents, in all respects as required by the Statutes, Letters Patent No. 1,705,341 entitled Glass Blowing Machine and dated March 12, 1929 were granted to him as assignor to The Owens Bottle Company as by said Letters Patent, or a duly authenticated copy thereof, ready in Court to be produced, will appear.

5. That prior to the issuance of said patent No. 1,705,341 by assignment in writing duly executed and recorded in the United States Patent Office, the entire right, title and interest in and to said application Serial No. 659,451 and the resultant Letters Patent No. 1,705,341 and the invention thereof were sold, assigned and transferred and set over unto the Plaintiff herein and under and in accordance with such assignment the said patent No. 1,705,341 was issued to the plaintiff herein as assignee of the said Leonard D. Soubier and since said assignment and since the date of issuance of said patent No. 1,705,341 the plaintiff has been and now is the sole and exclusive owner of said Letters Patent No. 1,705,341 and of all rights thereunder and interest therein as will more fully appear in and by said assignment or duly authenticated copy thereof in Court to be produced and profert of which is here made.

6. That subsequent to the issuance of said Letters Patent No. 1,705,341 the name of the plaintiff herein was changed from The Owens Bottle Company to the Owens-Illinois Glass Company.

7. That the defendants and each of them having knowledge of the existence of said Letters Patent No. 1,705,341 and of this plaintiff's ownership thereof and since the grant thereof and the assignments thereof to the plaintiff as well as within six years prior to this bill of complaint have jointly and severally unlawfully and without the consent of this plaintiff, manufactured, sold and used and offered for sale and use at Toledo, Ohio, within the Northern District of Ohio, Western Division, aforesaid and elsewhere within the United States devices in infringement of said Letters Patent No. 1,705,341, and still continue to so infringe and threaten to continue such infringement and that such infringement has resulted in great and irreparable damage to this plaintiff and plaintiff is without adequate and sufficient remedy at law and therefore brings this suit in equity.

8. The invention patented by said patent No. 1,705,341 is of great utility and benefit to the public and the public at large have recognized and acquiesced in the exclusive rights of the plaintiff in and to the end that this plaintiff has enjoyed the fruits and benefits of its exclusive rights and would continue to do so to its great financial gain and profit except for the acts of infringement and threats of these defendants herein complained of.

9. That since the issuance of said patent No. 1,705,341 plaintiff has notified the defendants of plaintiff's ownership of said patent and of defendants' infringement thereof, and that the defendants in the face of such notification have jointly and severally manufactured, sold and used, and offered for sale in the Northern District of Ohio, Western Division, aforesaid and elsewhere in the United States devices embodying the invention of said patent in direct violation of plaintiff's rights under said patent No. 1,705,341 and that well knowing the premises aforesaid the defendant, Frank O'Neill, has instigated, aided, and directed the defendant, The O'Neill Machine Company, in said infringing acts and has committed the infringing acts aforesaid both in his individual capacity and as the directing officer of said defendant, The O'Neill Machine Company.

WHEREFORE PLAINTIFF PRAYS:

(a) That the defendants and each of them be brought before this Court by process of subpoena and required to answer the matters recited in this bill of complaint but not under oath, answer under oath being hereby expressly waived.

(b) That the defendants and each of them may be decreed to account for and pay over unto this plaintiff all such gains and profits and advantages as have accrued to or been earned or received by the defendants and each of them, and all such gains, profits and advantages as would have accrued to or been earned by the plaintiff but for said infringement and said wrongful acts, together with all damages that this plaintiff has sustained by said infringement and that this Court shall increase such damages as in its judgment shall be deemed just.

(c) That the defendants and each of them and the officers, agents, servants, workmen, and employees thereof be temporarily restrained and enjoined pending this suit and afterwards perpetually restrained and enjoined from trespassing upon the rights of this plaintiff as aforesaid and from directly or indirectly making, using or selling or causing to be made, used or sold or offered for use or sale devices embodying the inventions of said Letters Patent No. 1,705,341 or from infringing upon the rights of plaintiff under said patent in any manner whatsoever.

(d) That the defendants be compelled to pay the costs of this suit and that the plaintiff may have such other and further relief as equity in the nature of the case may require and to this Honorable Court may seem just.

OWENS-ILLINOIS GLASS COMPANY.
(Signed) James Morrison,
Vice-President.

November 15, 1929.

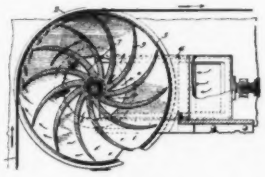
Geddes, Schmettau, Williams, Eversman & Morgan,
Solicitors for Plaintiff.
(Signed) W. J. Belknap,
(Signed) C. B. Belknap,
Of Counsel for Plaintiff.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

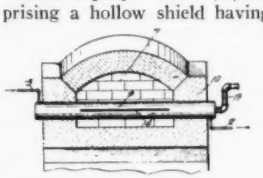
Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

DRAWING CONTINUOUS SHEET GLASS. U. S. 1,735,573. Nov. 12, 1929. John C. Henderson, New York, assignor to Libbey-Owens Glass Company, Toledo, O. Filed 10/30/26. An improved method and apparatus for bending the plastic glass sheet from one plane to another without injuring the surfaces thereof. The plastic sheet, after becoming partially set, is gripped adjacent its edges, and supported upon suitable members which move with the sheet during its bending operation. A pair of rather large metal discs or wheels may be used, which are so mounted that their sheet-edge carrying surfaces diverge from one another as they move with the sheet so that a constantly increasing lateral tension is applied to the glass sheet throughout the bending operation. This lateral tension will tend to prevent sagging of the unsupported main central portion of the sheet, which is carried from the vertical into the horizontal plane without contacting with any solid bodies which might otherwise injure the delicate fire-polished surface of the sheet.



Central portion of the sheet is carried, during the bending operation, upon a blanket of air under pressure. More specifically, a casing, substantially enclosed except for that face adjacent the glass sheet, is mounted beneath the bending arc of the sheet, and compressed air is forced therein, and impelled toward the sheet surface and in the direction of the sheet's travel, by means of a driven fan member within the casing. In this way a continuously renewed blanket of air under pressure is maintained beneath the central portion of the sheet during the bending operation, which will cooperate with the lateral tension applied from the edge supporting members to prevent any material sagging of the central portions of the sheet.

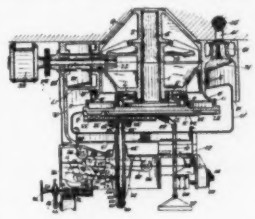
GLASS-MELTING FURNACE. U. S. 1,731,248. Oct. 15, 1929. Nestor Mambourg, Lancaster, O., assignor to The Libbey-Owens Glass Company. Filed 6/4/24. In a glass furnace, a burner comprising a hollow shield having spaced inner and outer cylindrical walls which have a longitudinal slot in one side thereof, means for creating a continuous circulation of cooling medium between said inner and outer walls, and a gas-pipe extending longitudinally through said shield, said gas-pipe being spaced from said cylindrical walls and provided with a longitudinal series of openings communicating with the interior of said shield.



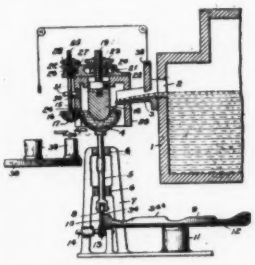
ABRASIVE-FEEDING SYSTEM FOR GLASS-GRINDING MACHINES. U. S. 1,735,600. Nov. 12, 1929. Joseph P. Crowley, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 12/24/23. An invention whereby new or used sand collected from the several grinding units is mixed with water and then flowed through a series of grading tanks in which the abrasive is separated into a plurality of distinct grades. Preferably, two similar series of these tanks are provided, and while the abrasive mixture is flowing through one series and being graded, the previously graded abrasive in the other series of tanks may be drained off into a series of storage reservoirs, each reservoir being adapted to hold one grade of abrasive and being provided with a suitable agitator maintaining the abrasive in suspension. This comprises the grading system.

The feeding system consists of a series of endless pipe circuits extending past the several grinding machines. A certain grade of abrasive is maintained in practically continuous circulation in each pipe circuit, and may be drawn upon when desired to supply the need of any one or more of the grinding units.

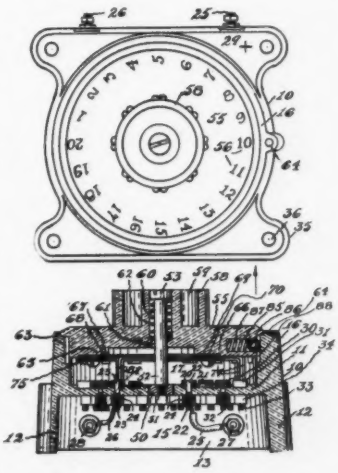
APPARATUS FOR SURFACING PLATE GLASS. U. S. 1,735,599. Nov. 12, 1929. Joseph P. Crowley, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 8/27/23. In an apparatus for surfacing sheet glass, a sheet-supporting table rotatable about a vertical axis, a surfacing element resting freely on the upper face of the sheet, means for rotating the table, means for raising and lowering the surfacing element to and from contact with the sheet, and automatic control mechanism for lowering the surfacing element into engagement with the sheet, starting the rotation of the table, and after a predetermined time elevating the surfacing element and stopping the table.



METHOD OF AND APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,732,773. Oct. 22, 1929. Daniel A. Ripley, Aspinwall, Pa., assignor to Hartford-Empire Company, Hartford, Conn. Filed 2/20/20. In a machine for feeding molten glass, the combination with a container adapted to contain a pool of molten glass, means for continuously supplying glass thereto, and a displacement member adapted to co-operate with said container to expel successive quantities of glass therefrom, of means for operating said parts in successive strokes and for varying in predetermined order the amplitude of successive strokes for the successive expulsion from said container of different predetermined quantities of glass.



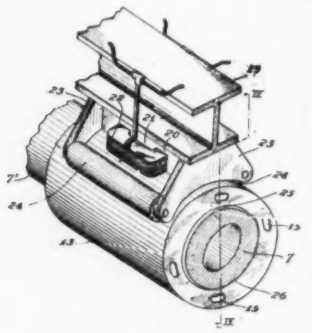
SELECTIVE PYROMETER READING SWITCH. U. S. 1,735,485. Nov. 12, 1929. Edward Williams, Pelham, N. Y., assignor to Wilson-Maeulen Co., Inc., N. Y. Filed 1/12/28. One object of the invention is to provide a single compact dial pyrometer switch which will selectively connect any one of a series of contacts with another contact and make good contact at any selected position.



Other objects are to provide a single yieldable positioning means for switches of this kind, to provide a conveniently molded combined base and housing for the switch and leads, and to provide an efficient method for making contact segments for a switch of this kind. A further improvement relates to the dial portion thereof, wherein said dial, which is preferably made of dielectric material has a plurality of resilient contact brushes thereon, these being interiorly located to cooperatively relate to contacts mounted upon and within the associate base, during operation. Said dial is further provided with indices upon its exterior face which register with an index point upon the housing whereby operating positioning of the dial carried brushes upon the

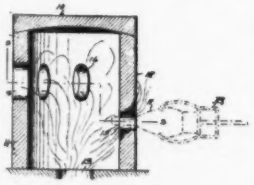
base contacts are numerically, or otherwise indicated, in readable registry with the dial and base indices. Cooperating means upon the base and dial are also provided to cause predetermined contact and registry of brushes with contacts and position indication.

APPARATUS FOR ROLLING GLASS. U. S. 1,732,042. Oct. 15, 1929. John H. Fox, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, Pittsburgh, Pa. Filed 6/25/28. The combination with a glass casting roll, of a sizing roll thereabove comprising a cylindrical casing, a glass engaging jacket mounted on the casing consisting of a series of collars placed end to end and each having a loose fit on the casing, and means for holding the collars so that their interior surfaces are out of contact with the periphery of the casing along the portion thereof most remote from the periphery of the casting roll.



APPARATUS FOR POLISHING PLATE GLASS. U. S. 1,733,295. Oct. 29, 1929. Joseph P. Crowley, Toledo, O., assignor to Libbey-Owens Glass Company. Filed 7/27/23. New and improved apparatus for polishing the surfaces of flat-ground sheets of glass. This system is most advantageously employed for surfacing sheets of standard size and shape, preferably square. All of the edges of these sheets or blanks are slightly beveled to avoid chipping or fracturing of the sheet during the surfacing operation. Preferably, each individual grinding or polishing machine is adapted to work upon a single size sheet, and upon one sheet at a time, although a machine may be adapted for surfacing sheets of various sizes, or for surfacing more than one sheet at a time. The sheet or blank is not secured to the supporting table by plaster, but is merely placed loosely in a shallow recess in the table top, this recess preferably conforming to but being slightly larger than the glass sheet.

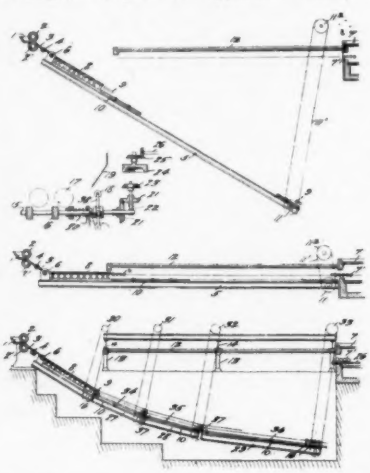
GLORY-HOLE FURNACE. U. S. 1,735,775. Nov. 12, 1929. Melvin Elias McSwain, Fort Smith, Ark. Filed 12/20/28. Object of the present invention is to form the finishing hole so that the hot gases or blast are directed upward and outward instead of directly in a horizontal plane so that the flame does not strike the bulbous portion of the chimney but only the tip thereof, thus preventing the softening of the article and its consequent deformation by the resilient grip of the handling jack or clamp. To provide "glory hole" or glass furnace of the character described which has one straight wall and a curved wall, the straight wall being formed with a plurality of finishing holes and the curved wall with a plurality of flame or blower holes.



FRAMEWORK FOR GLASS-POLISHING UNITS OR THE LIKE. U. S. 1,735,410. Nov. 12, 1929. Archie W. Platt, Toledo, O., assignor to the Edward Ford Plate Glass Company, Rossford, O. Filed 3/21/27. An invention for the provision of a framework which is simple and comparatively inexpensive and at the same time strong and durable in its construction, and has its main girders so arranged as to afford a maximum support for a plurality of operating units with the use of a minimum of material and in such manner that they may be easily and quickly mounted in or removed from operating position thereon.

GLASS-DELIVERING APPARATUS. U. S. 1,735,551. Nov. 12, 1929. David Stenhouse, Washington, Pa., assignor to Hazel-Atlas Glass Co., Wheeling, W. Va. Filed 7/23/24. The invention relates to a means by which the glass, as delivered to the forming apparatus, will be of uniform temperature. As the plunger ascends the unsevered portion of glass adhering thereto is drawn up into the mass of glass in the flow spout, and as it is drawn upwardly into the mass it is caused to rotate by the continuous rotation of the plug; and as a result of this rotation the unsevered portion is more intimately mixed with the glass mass in the flow spout, thereby producing a uniform temperature.

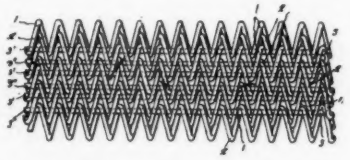
PROCESS AND APPARATUS FOR THE MANUFACTURE OF GLASS. U. S. 1,732,889. Oct. 22, 1929. Charles Heuze, Auvelais, Belgium, assignor to The American Bicheroux Company. Filed 6/18/28 and in Belgium 3/3/28. An apparatus which, in simple manner, permits of forming the plates or sheets at high speed and then annealing them while traveling at reduced speed.



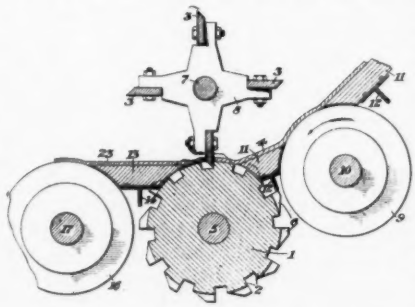
For this purpose it comprises as the sheet is formed, in delivering it onto an inclined runway provided with sheet carrying rollers so that the forward movement of the glass is effected at first under the action of gravity, and in modifying the inclination of this platform so that once the sheets or plates are completely delivered to the runway, they can be introduced into an annealing apparatus at the speed at which they are to move in this apparatus.

It also comprises in modifying or changing the inclination of the runway so as to compensate for the acceleration due to gravity.

WIRE FABRIC. U. S. 1,735,788. Nov. 12, 1929. Edward F. Pink, Cambridge, Md. Filed 3/15/28. A wire fabric formed of wires twisted into spiral shape, some of the spirals being right-hand ones and others left-hand ones, the right-hand spirals being alternately arranged with respect to the left-hand spirals, and staple-shaped wires connecting the spirals together, one limb of each staple passing through the vertices of each pair of right-hand spirals, and the other limb of each staple passing through the vertices of each pair of left-hand spirals.

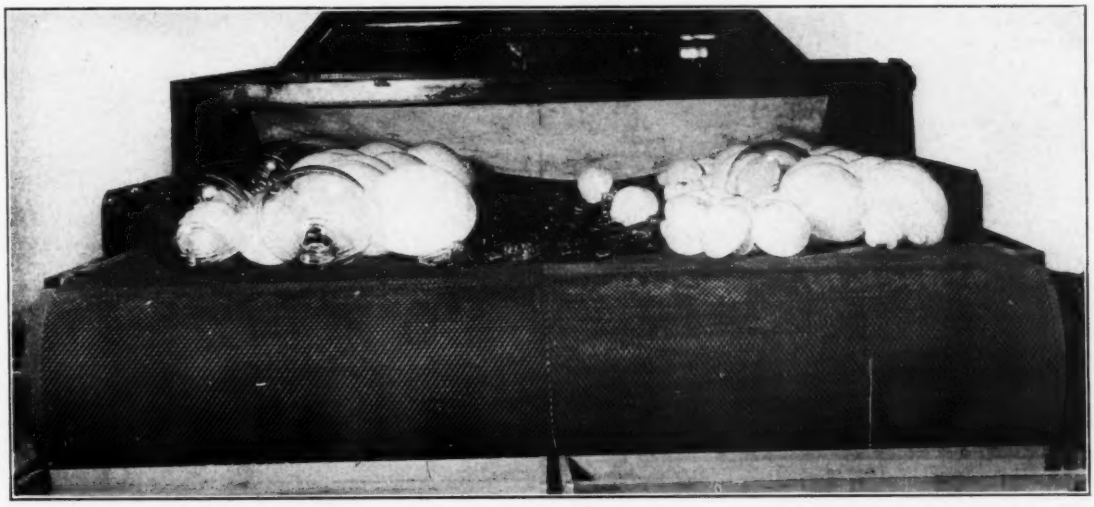


PRODUCING SHEET GLASS. U. S. 1,734,250. Nov. 5, 1929. Nicklas Franzen, Long Beach, Cal., assignor to Mississippi Glass Company. Filed 5/15/25. In combination with a glass melting furnace, means for forming sheet glass comprising forming rolls, and sheet severing means comprising sets of cylically successively engaging shearing members, and sheet propelling means comprising driven rolls with refractory sheet supporting members intermediate them. Also means for severing formed sheets into smaller sheets and means for propelling sheet glass between said cooperating members, and flangial extensions on one of said members for guiding said sheet glass thereover.



New Herringbone Type of Woven Wire Lehr Belt

The application of the woven wire endless belt as a conveyor in glass annealing lehrs has involved a number of difficult engineering problems; among them that of counteracting the tendency of the woven fabric to creep sidewise on the driving rollers due to the convolutions of the sections when in contact with the



SHOWING THE HERRINGBONE CAMBRIDGE SPIRAL WOVEN WIRE BELT

drum over which they pass. This tendency causes the edge of the moving belt to drag against the guide or the wall of the annealing chamber, increasing friction and causing rapid wear and other damage.

Several methods intended to overcome this difficulty have been worked out, patented, and put into practical use. The practice in most general use has been to build the belts in short right- and left-hand spiral sections extending the full width of the belt, these sections being strung alternately by means of cross-wires to connect them, thus forming a complete endless sectional belt.

Believing that further improvements and efficiencies were possible, the Cambridge Wire Cloth Company of Cambridge, Maryland, have worked out a new type of woven wire conveyor belt particularly adapted to glass annealing lehrs, with the helical wire members on each side of the middle line arranged reversely to those of the opposite half throughout the entire length of the belt, the tendency of the belt to creep thereby being prevented, the sidewise pull of one side of the belt evenly balancing the other.

This type of belt has been installed in a number of glass factories and is said to have proven itself to have a number of advantages over the earlier types in general use. The herringbone weave being continuous throughout the entire length of the belt, all crosswise connecting bars between sections are abolished, for the belt, not being built in sectional form, needs no such bars. Because of its unique construction it is a self-guiding belt and it is claimed will not creep to either side irrespective of the radius of the driving drum.

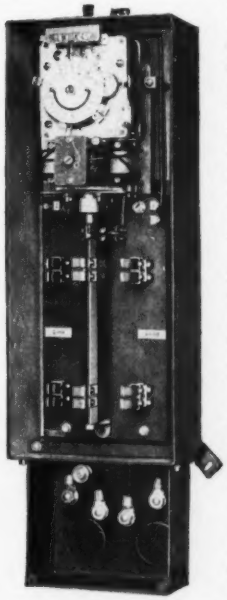
This belt is known as the Cambridge herringbone spiral wire belt. It is covered by United States patent No. 1,707,567 issued April 2, 1929. The belts are being manufactured by the Cambridge Wire Cloth Company in accordance with the description given in the patent.

New Instrument Catalogs

Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa., recently issued several catalogs as follows: No. 60—"Photometers." This has been entirely rewritten. No. 86—"Optical Pyrometers," revised. No. 87—"Potentiometer Pyrometers," revised. No. 93—"The Homo Method for Production Tempering," completely revised. Notebook No. 4—"Notes on the Kelvin Bridge," new publication. No. 87 first gives some general facts concerning types of pyrometers in general commercial use, describes thermocouple pyrometers, temperature indicating and recording equipments, automatic central station equipments, automatic control equipments and devotes two pages to the theory of the potentiometer pyrometer. It gives a list of pyrometer definitions and a price list of the products referred to in the catalog. No. 86 is devoted to the L & N optical pyrometer, theory of temperature measurements with this pyrometer, its applications and a price list.

Self-Winding Time Switch

The Sauter single-throw self-winding time switch here illustrated, for circuit control, is used to turn on and off blowers, pumps, ventilators and other electrical circuits that can be operated on a predetermined time basis; timing of processes, pre-heating of kilns, etc. The main switch is motor operated, air-brake, rotary and self-winding. The motor is of the universal series-wound type, with jumper arrangement on the field coils to permit operation on 115 and 230 volt direct current or alternating current of any frequency. The clock has a four-day mainspring, but is rewound automatically twice every 24 hours.



The clock can be furnished with a Sunday cut-out automatically causing the switch to suspend its functions every seventh day. A single 24-hour dial serves both for time setting and for program setting. Where it is desired to have the operations conform to a constant schedule the plain dial is used. For lighting circuits on an all-night or part-night schedule the astronomic dial is recommended, as it automatically resets the daily operations to conform to local sun time, to dusk or to dawn, or to both. The switch is distributed by R. W. Cramer & Company, Inc., 136 Liberty Street, New York.

FUTURE OF LAMINATED GLASS LOOMS LARGE.—World registration of automobiles on January 1, 1929, according to U. S. Government figures, was 32,028,584 of which 24,629,921 were in the United States. Passenger cars in this country numbered 21,423,597, most of them of the enclosed type requiring an average of more than 20 square feet of windshield, door and window glass, or 40 feet if laminated. Figure out the future for yourself.

A Modern Lehr Loader

Mechanical loading of hot formed articles such as bottles and the like directly into the glass annealing lehr has been greatly simplified by the introduction of the woven wire lehr conveyor with its level, smooth surface of low conductivity. The elimination of labor for "carrying in" has been one of the most perplexing problems confronting the glass manufacturer and constructing engineers for twenty-five years, or since the development of automatic machinery for ware production.

Many forms of leaders have been built, tried and found wanting in some detail. In designing and applygin these machines some fundamental detail was usually wrong and failure to consider every phase of the work to be done caused early abandonment of the devices.

The causes of most loader failures in the past were as follows:

1. CHECKED WARE. Inadequate heating of lehr conveyor. Remote position of large lehr. Discharge position of ware to Lehr Conveyor. Type ware conveyor to lehr.

2. MECHANICAL FAILURE. Complicated machine design. Method of application to lehr. Overheating parts requiring lubrication at lehr. Unsuitability of lehr conveyor during early attempts to utilize loaders, warped pans, etc. Clogging of loader conveyor with ware during job changes caused by poor timing, etc.

3. DESIGN FAILURE. Falling ware due to push bar loaders. Falling ware due to high speed loader conveyors delivering ware at a fixed temperature to a remote lehr. Falling ware due to use of rotary disc changing path of ware travel. Falling ware due to plates between loader and lehr conveyors. Broken ware due to use of push bar. Stuck ware due to mass pushing or dependence on successive continuous rows for supporting each other.

4. APPLICATION FAILURE. Impossibility of adapting loader to various types of bottles and lehrs in various positions with respect to the bottle producing units. Due to variation in types of ware to be handled, due to variation in lehrs to which loaders are applied. Excessive cooling of ware prior to delivery to lehr. Inadequate knowledge of the physical conditions surrounding the handling of heated glass articles.

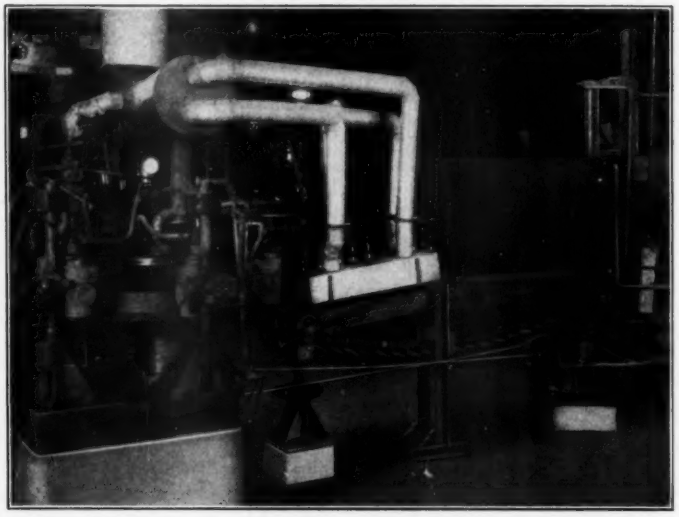
There were undoubtedly many other causes of failure due to the variation in factory conditions, any of which would develop one of the general faults enumerated above.

THE AMCO LOADER AND UNIT LEHR

In the design of a successful lehr loader all of the causes of failure in early loaders required serious consideration by experienced engineers qualified to design a simple mechanical device which will deliver the ware directly into the lehr after setting its form supporting enamel or skin. Such a loader requires an individual lehr which can be constructed adjacent to the forming machine. This permits the use of a standard design which will function with any ware that will stand unsupported while being moved in a straight line toward the lehr. The width of lehr required to receive the general line of ware from Lynch or O'Neill Machines varies from 36" to 48", but the loader may be used without change on either lehr.

REQUIREMENTS OF IDEAL LOADER AND LEHR INSTALLATION

1. Positioning of lehr and loader at machine to control thermal characteristics of heated glass and uniform delivery into annealing lehr.
2. Utilization of sensible heat of formation to aid annealing and reduced fuel consumption.
3. Individual small lehr for forming machine.
4. Smooth fabric conveyor to assure level support for ware after delivery by loader.
5. Heating of loader directly by lehr muffle to maintain all contact points properly heated for ware without auxiliary burners.
6. Means for supporting ware in loader prior to delivery in lehr.
7. Means to instantly adjust loader to receive all heights and sizes of bottles.
8. Segregation of ware in rows in lehr.
9. Synchronization of loader with machine to eliminate timing devices.
10. Support ware from base to avoid finish checks.
11. Deliver ware by carrier instead of pushing into lehr.
12. Accessibility for hand loading lehr without removing loader.
13. Means for assembling heavy ware for precooling surface enamel prior to delivery into lehr.



INSTALLATION AT PLANT OF CONSOLIDATED LAMP AND GLASS COMPANY

14. Elimination of high speed fast wearing parts and substituting an air motor drive similar to the forming machine actuating mechanism.
15. Variable lehr conveyor speed.
16. Variable loader speed to increase or decrease annealing time independent of forming machine production rate.
17. Low installation cost to return adequate savings on investment.
18. Low upkeep expense.

The AMCO LOADER differs greatly from other types in that it is synchronized as a mechanical unit with the bottle machine and so located as an extended portion of the lehr that its thermal requirements are satisfied by the heating element in the lehr without auxiliary heating means. It is the compact relation of the forming machine, loader and lehr made possible by the unique type of loader and the small lehr which produces the ideal device for handling hot glass articles.

The frequent job changes in machine operation requires an escalator conveyor to receive the various heights of articles as produced. This style of conveyor enables the loader link to be built extremely short and all articles enter the lehr quickly retaining a regulated portion of the sensible heat of formation. When heavy articles such as quart bottles are being produced, the desirability of this arrangement is reflected by the exceedingly low fuel consumption of the lehr. In operation the articles enter the lehr through a small opening in the insulated loader housing and no heat is lost which is required in the annealing process. In the relation of the loader to the machine and lehr, this lehr is unique. In its design long sloping bucks, revolving discs or transfering of heated ware on a series of cold conveyors have been avoided.

The close arrangement of the machine, loader and lehr places the care of the entire operation in the hands of the machine operator.

In the accompanying photograph the machine is shown at the left of photograph, the escalator portion of the loader in the center with wind pipes to control the setting of the ware, the opening for ware entering lehr is shown at upper end of escalator, the transfer mechanism to lehr is located in the insulated housing over the level portion of loader. The photograph is touched up to show the usual transfer mechanism or take-out device of the machine which delivers the ware directly on the loader. The opening for ware entering the lehr is also marked to show the small space required and open to the atmosphere.

The Glass World and What It Is Doing

News of the Industry

Frank O'Neill and His Activities

The recent development of the new vacuum bottle machine at the plant of the O'Neill Machine Company, Toledo, Ohio, makes this an unusually opportune time for briefly reviewing the career of its inventor, Frank O'Neill, president of that company. This is not the first of Mr. O'Neill's accomplishments in the development of automatic glass working machinery. For many years he has devoted all of his time to that line of effort for which his early training had thoroughly fitted him.

At the age of fifteen he began to learn the trade of moldmaker in the plant of the Buckeye Glass Works, Martins Ferry, Ohio. After mastering the trade he worked as a journeyman in a number of different shops, acquiring a very broad experience which has been of much benefit to him in later years when working out his plans for designs of automatic machinery of various types. Among the plants in which he gained experience was the Atterbury Works in the South Side of Pittsburgh; the LaBelle Glass Works, Bridgeport, Ohio; Hoggs Glass Works, Wheeling, West Virginia; Belmont Glass Company, Bellaire, Ohio; Butler Glass Works, Fostoria, Ohio, and the Columbia Glass Company, Findlay, Ohio.

In 1890 he launched into business for himself, starting a mold shop at Fostoria, Ohio., where he began his first experiments with automatic glass working machinery.

In the year 1893, Mr. O'Neill built an automatic power driven press, which was used for the manufacture of glass vault lights. An outstanding feature of this machine was the use of two springs for controlling the setting pressure on the glass. This method of controlling the set is used on all power-driven presses of today.

This machine was fed through a feeder box, either by ladle or continuous flow. When fed by means of a ladle, some difficulties were encountered although the machine produced good finished ware. At this time, continuous melting tanks were just coming into use, and little was known of their merits. Had the existence of tanks of this kind been known when the machine underwent its initial trial under glass, it would have operated—as it did a short time later—with very good success, by allowing the glass to flow from the tank between discs and be cut into gobs by shears and allowed to fall into a mold located directly beneath it.

The first tumbler machine mechanically driven, having six plungers and fed by two gatherers, was brought out by Mr. O'Neill in 1898, at Cicero, Ind.

Quite a number of glass working machines were built in the next few years and finally in 1912, after 20 years of experimenting and building, he established The O'Neill Machine Company of Toledo, Ohio. This company gained an enviable position in the glass industry through Mr. O'Neill's skill and experience in the development of automatic glass working machinery.

During the following years the machine company developed and constructed several tumbler machines, wide mouth press and blow, No. 21 semi-automatic machine, seven or more completely automatic machines, and special models, until the present time, when they are manufacturing the new vacuum fed machines Nos. 60 and 70 on a large scale.

So great has been the demand for the new vacuum bottle machines that the factory and equipment have been doubled, and is now operating at full capacity night and day.

The O'Neill Machine Company is represented in the United States for the sale of the new O'Neill vacuum machines by The Knox-O'Neil Company, Knox, Pa., and in Europe by The O'Neill Machine Company, 10 Savoy Street, Strand, London, W. C. 2, England.

Big Increase in Plate Glass Production

The production of polished plate glass for the month of October, 1929, was 14,620,904 sq. ft., as compared with 14,010,681 sq. ft. produced in the preceding month, September, 1929, and 11,140,217 sq. ft. produced in the corresponding month last year, October, 1928. The October, 1929, production was over one-third larger than that of the same month last year.

Annual Meeting of American Ceramic Society

The 32nd annual meeting of the American Ceramic Society as previously announced is to be held at the Hotel Royal York, Toronto, Canada, next February 16-20, inclusive. Arragements have been made to show exhibits of light factory equipment, ceramic materials, and products in the Convention Floor Foyer and in the Lounge on the Mezzanine Floor. Registration will be in the Convention Foyer. Meetings will be held in the Ball Room and in the two Halls on the Convention Floor. Also in private dining rooms 9, 6, 1 and 2. Exhibition space rental including furniture and signs will be 59c per square foot, minimum space 50 square foot per exhibitor.

The Society nominating committee No. 1 has reported nominations for 1930 and 1931 as follows: Committee No. 1, for president, Edward Orton, Jr.; for vice-president, Paul E. Cox; for treasurer, H. B. Henderson. Committee No. 2, for president, Edward Orton, Jr.; for vice-president, Alexander Silverman; for treasurer, H. B. Henderson.

Both nominating committees under the chairmanship of E. Ward Tillotson and L. J. Trostel, respectively, have nominated General Orton and it requires only his acceptance of the presidency to assure the Society of the extraordinary benefits that will accrue from his administration of that office during the coming year. It is understood that General Orton may condition his acceptance on an assurance that the Society will resume its former policy of giving special recognition to members who have earned it by notable achievements in ceramics or who have served ceramic science and technology with distinction. No definite statement, however, has been made as to the exact form such recognition may take.

Trips to varied industrial plants are being planned. The Canadian committee in charge is making every effort to provide attractive entertainment of interesting character for its ceramic friends from this side of the border.

Tours about the city, visits to museums, the university, and other points of interest have been planned. The meeting will open with a reception at the headquarters hotel, Royal York, on Sunday by Canadian ceramists, public officials, and others, with an organ recital and concert with a chorus of 200 voices on Sunday evening.

Railroads are offering one-half fare rates on return trip on the certificate basis. The Royal York Hotel has made a flat rate of $5.00 and $8.00 a day, respectively, for single and double rooms.

New Ceramic Building Needed by Alfred University

An appeal is being made to Governor Roosevelt of New York to include in the State's budget the sum of $175,000 for a new ceramic school building at Alfred University, Alfred, New York. The present building was erected nearly thirty years ago with a small addition a few years later, and was intended to provide accommodations for about fifty students with laboratory, studio and class room space. For twenty years it was large enough to accommodate the students of the school, but in the past ten years the enrollment has increased to over 160, three times the number provided for by the present building. It has been necessary to open temporary quarters in other buildings on the campus.

There are no rooms or facilities for a glass laboratory, which the glass industries of this state urgently need and the New York State Education Department desires shall be included in the work of the school. Request has been made annually for a half dozen years for an appropriation for this additional building. Once the Legislature voted the item but Governor Smith vetoed it on the ground that it should be included in the $100,000,000 ($10,000,000 per year for ten years) bond issue. It is now requested that Governor Roosevelt include the $175,000 approved by the State Education Department, in the budget request.

Brock Glass Company Expanding

Pursuant to a program of expansion, as of November 1, the corporate name of the Brock Glass Company was changed to Consolidated Factories, Ltd., a California corporation having a capital stock of $250,000.

The new company will take over the assets of both the Brock Glass Company and the Consolidated Hardware Manufacturers, which latter concern has previously been located in Pasadena and primarily are metal converters, manufacturing door locks, cupboard latches and other items of builders' hardware in the assembly of which glass is used.

The new organization will be officered by the personnel of the consolidating companies, N. V. D. Brock continuing as president, and John G. Woods being installed as executive vice-president.

Two new buildings have been added to the group comprising the former Brock Glass Company plant; considerable new equipment has been added; a complete printing plant has been purchased; proposals are being accepted for the installation of a plating plant and foundry to be added the first of the year.

Feldspar Now Shipped in Paper Bags

The Feldspar Grinders' Institute, Inc., recently announced that its members will adopt the use of the five-wall paper bags designed to hold 100 pounds each of feldspar, for the shipment of feldspar instead of burlap bags. This decision was made after a special committee and the Institute as a whole considered the matter very carefully.

At a recent meeting of the F. G. I. held in Atlantic City it was considered to be of mutual advantage for the manufacturer and the customer to change to these paper bags. This change goes into effect on December 1, 1929, the bags to be billed to the customer at cost and not to be returnable. Up to December 1, 1929, the burlap bags will be handled in the same manner as before by the F. G. I. members. The advantages and disadvantages of this subject were considered by the members, and it was felt that the adoption of paper bags would mean less loss of spar, less contamination in transport, less breakage in packing and shipping, with the additional advantage of the packages being waterproof and easier to handle in transport.

It is expected that this innovation will be met with considerable favor throughout the trade.

At a recent meeting of the officers and directors of the Feldspar Grinders' Institute, Herreld Thropp was made vice-president of the Institute, the Eureka Flint & Spar Company of Trenton, N. J., with which company Mr. Thropp is associated having come in as a new member. The other vice-presidents are H. P. Margerum and C. H. Peddrick, Jr.

New Development and Consulting Organization

Irving E. Adams, a well known consulting glass technologist, announces that with Frank H. Mahoney, ceramic consulting engineer, there has been organized the Ceramic Products Development Company, Corliss Station, Pittsburgh, Pa. (Telephone Federal 3550). Mr. Adams is president of the company and Mr. Mahoney secretary and treasurer. The change will not affect Mr. Adams' status as a consultant on glass problems. Personal trips to plants desiring to use his services will be arranged as in the past. In addition there will now be access to manufacturing facilities and means for experimental research at high temperatures, also complete analytical equipment. Also it will be possible for these advisors to do much more work in the ever expanding field of colored glasses.

Glassmen Speak at Bankers Exposition

The glassware and crockery industries were invited to attend the Bankers Industrial Exposition now permanently held at West 42nd Street, New York, on October 31, which was set aside as Crockery and Glassware Day. The speakers scheduled for the noon-time program of that day were Alexander Silverman, head of the Department of Chemistry at the University of Pittsburgh; Ross C. Purdy, general secretary of the American Ceramic Society and James Maloney, president of the Glass Bottle Blowers Association of United States and Canada. The speeches were broadcast over station WRNY from 1:00 to 1:30 P. M.

Professor Silverman also addressed the local section of the American Chemical Society at the City Club, Chicago, on Friday evening, November 22, his subject being "Glass Manufacture in the Twentieth Century."

Recent Construction Records

October construction contracts awarded in the 37 states east of the Rocky Mountains show a slight increase from September but a decrease from the preceding October, according to F. W. Dodge Corporation. October's total, $445,642,300 in amount, was $240,000 greater than September, 1929, record but was off 25 per cent when compared with the October, 1928, total. The September volume of contracts amounted to $445,402,300.

Will Speak on Glass Manufacturing Control

The Pittsburgh Section of the American Ceramic Society will meet Tuesday evening, December 10, at 8 P. M. in the auditorium of the Bureau of Mines, 4800 Forbes Street, Pittsburgh, when W. C. Taylor, chief chemist of Corning Glass Works will speak on glass manufacturing control. The meeting will be open to anyone interested in glass technology.

Trade Activities

The Michigan Glass Company, Flint, Mich., has increased its capital stock from $10,000 to $50,000.

The Lenoir Mirror Company, Lenoir, N. C., has been incorporated with a capital of $150,000 by A. G. Jones, A. Garland and others.

Eye Pleas Auto Lens Corporation, Fairmont, W. Va., capitalized at $100,000 was incorporated by L. G. Giordano, Michele A. Forte and others.

The Scohy Sheet Glass Company, Sistersville, W. Va., is resuming manufacturing operations after an extended shutdown during which various improvements were made to plant and equipment.

The Steubenville Plate and Window Glass Company, Steubenville, O., on November 8 met with a heavy loss from fire. A stock said to be valued at $16,000 of plate glass, mirrors, moldings, etc., was destroyed.

The Morris Glass Company, Inc., 8702 Kercheval Avenue. Detroit, Mich., has been incorporated with $50,000 capital stock to manufacture and deal in glass products. Lester L. Morris, George B. Wright, Clara D. Campbell are the incorporators.

The Randolph Silica Products Company, which recently entered the glass sand production business and completed construction of a large modern plant equipped for hydraulic mining of the sand at Randolph, Oklahoma, have established their main office at 500 Perrine Building, Oklahoma City, Oklahoma.

William H. Lewis, who has been connected as secretary, treasurer, and general manager with the Brock Glass Company, Santa Ana, Cal., now known as the Consolidated Factories, Inc., has resigned from that company. No announcement has been made as to his plans for the future.

The National Plate Glass Company's Illinois Division plant at Ottawa, Ill., closed down about the middle of November for an indefinite period. It was said that about 950 workers were laid off and that the plant of the Federal Division adjoining the Illinois Division plant and at one time the property of the Federal Plate Glass Company, where about 250 men are employed, will continue to operate.

The Triplex Safety Glass Co., Ltd., of England according to a report received in this country recently informed its stockholders at their annual meeting that the Kings Norton factory is now producing about 2,000,000 feet of glass annually. This factory started production 18 months ago. It was also stated that Triplex safety glass is being used in 75% of the motor cars in Great Britain.

The Standard American Glass Company, Santa Ana, Cal., according to A. N. Zerman, chairman of the Industrial Committee of the Chamber of Commerce in that city, is making plans for reopening their plant on a large scale. The company discontinued operations some time ago, having become overstocked. It is said that this stock has been practically all disposed of and that manufacturing operations will begin shortly. It is announced that its old factory will be remodeled by putting in new machinery for making glass by the flat drawn process.

The United Feldspar Corporation, 10 East 40th Street, New York, controlling and operating the Tennessee Mineral Products Corporation, Oxford Mining and Milling Company, Inc., United States Feldspar Corporation and New York Chemical Company announce that the Roessler and Hasslacher Chemical Company has been appointed their exclusive sales agent.

The West Virginia Glass Specialty Company, a new organization, recently purchased the old Interstate Window Glass plant No. 4 at Weston, W. Va. and will manufacture colored glass tableware. A crew of men are at work remodeling the plant and manufacturing operations are expected to begin early in January. It is said that the new plant will eventually employ over 400 men. Louie Wohinc, president; E. Hager, vice-president; John C. Weber, Jr., secretary; Ray C. Lorentz, treasurer.

American Window Glass Company, Factory No. 2, Jeannette, Pa., announced the cessation of blowing operations at the factory on Friday, November 8, at midnight. This marked the end of the cylinder process operation by the company. Contracts will be let for the installation of the Fourcault process as rapidly as possible. During installation the factory organization has been reduced to a minimum. Upon comple- of the improvements operations will be resumed under the new method.

Industrial Publications

Potentiometer Recording Pyrometer, Wilson-Maeulen Co., Inc., 385 Concord Ave., New York, Catalog Section P-1929. An eight-page pamphlet illustrating and describing their new model 8201 with a twelve-inch wide record chart, automatic electric cold junction compensator, external electric motive power, three different speeds of chart travel. This instrument was fully described in The GLASS INDUSTRY, November, 1929, page 275.

Recent Deaths

Walter Cox

News of the death of Walter Cox, president of the Pennsylvania Wire Glass Company, Philadelphia, Pa., on October 17 was received by the trade with great regret.

Francis Gardiner

Announcement was made in November that Francis Gardiner, formerly connected with Semon Bache & Company, importers and dealers in mirrors, glass, etc., died at Miami, Fla., on the 13th of that month.

William J. Golightly

William J. Golightly, manager of the Kokomo, Ind., plant of the Pittsburgh Plate Glass Company, died suddenly, it is believed of a heart attack, early in November. Services held on Thursday afternoon, November 7, were attended by many prominent glass men from the main office at Pittsburgh and the company's various plants.

Jefferson D. Robinson

Jefferson D. Robinson, president of the Libbey Glass Manufacturing Company, of Toledo, died on November 8. He was 68 years old.

At the age of 19 Mr. Robinson entered the employ of the Libbey Company, starting as an office boy. When the plant moved to Toledo 41 years ago, he accompanied the late E. D. Libbey and his associates to that city and established the present Libbey Glass Manufacturing Company.

His two sons survive, Joseph W. Robinson who now is vice-president and executive head of the company and his brother, Jefferson D. Robinson.

Coming Meetings

The National Glass Distributors' Association will hold its 15th annual meeting at the William Penn Hotel, Pittsburgh, December 3, 4 and 5. Wednesday evening, December 4, the members will be guests of the Plate Glass Manufacturers of America at a banquet to be held at the William Penn Hotel.

The American Society of Mechanical Engineers will hold their annual meeting in New York on December 2-6, 1929. There will be 29 technical sessions including meetings devoted to materials handling, fuels, industrial power, lubrication, etc.

What The World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C.

New Zealand—41736. Glass-beveling machinery.

Philippine Islands—41770. Vacuum botles.

Colombia—41792. Drug-store bottles and bottle-sealing caps.

South Africa—41855. Fancy and plain bottles all sizes, with screw and plain tops, corks, and stoppers.

Azores—42241. Milk bottles.

Philippine Islands—42294. Glass and porcelain ware, dinner sets and odd pieces, 5 and 10 cent grades.

Austria—41624. Industrial chemicals.

Italy—41551. Pyroxylin sheets.

Canada—41555. Lamps and shades, table and floor.

Porto Rico—41637. Lighting fixtures, chandeliers, etc.

Honduras—41596. Paint guns and compressors.

Germany—41645. Pumps of the centrifugal or reciprocating type, and air compressors.

France—41553. Calcium carbonate, copper, sulphur, lead, barium, potassium, sodium, bismuth, cobalt, nickel, manganese, tin, phosphorus, uranium, and zinc salts.

France—41622. Gold, platinum, nickel, strontium, tin, zinc, salts, barium, copper, lead, magnesium, antimony, sodium, potassium, and cobalt.

Canada—41639. Small glass bottle for containing one liquid imperial gram, 50 and 100 gross lots.

Colombia—41576. Glass tumblers for candy containers.

Canada—42150. China clay.

Argentina—42149. Pharmaceutical glass containers.

India—42145. Glassware.

Inquiries Received

For further information address THE GLASS INDUSTRY

477. We would like to obtain the names of the glass manufacturers in this country and Canada who are manufacturing flat glass so produced as to permit the admission of ultra-violet rays from sunlight.
478. Will you please give us the names of some of the large makers and users, in Chicago, of broken and powdered glass.
479. Who can make for me a 10" oval glass for an old clock to be 1½" high on under side. Also a glass globe to cover another clock 13½" high by 8"x10".
480. Who makes a line of cheap glassware known as the "Marjory Cut Glass Assortment" packed in barrels and consisting of six dozen pieces, vases, bowls, sugars, creams, etc.

READERS' WANTS AND OFFERS

BOTTLE AND TABLEWARE DESIGNER

WANTED:—Highly qualified designer of glass factories for bottle, and tableware, thoroughly acquainted with construction of furnaces, feeders, lehrs, etc. Position in the South of Soviet Russia. Apply to Mr. Morris Holtman, c/o Amtorg Trading Corporation, 261 Fifth Avenue, New York City.

LYNCH MACHINE OPERATORS

WANTED:—Several Lynch Machine operators, highly qualified for service in the South of Soviet Russia. Apply to Mr. Holtman, c/o Amtorg Trading Corporation, 261 Fifth Avenue, New York City.

For Sale: **CULLET** of all Descriptions
Free from Caps, Wires, etc.
GEORGE F. BAUMANN, Dealer,
1110 Carroll Street, Brooklyn, New York.
Carloads Ready for Immediate Shipment.

The New York Public Library in order to complete its files, desires to obtain copies of The GLASS INDUSTRY—issues of Vol. 2 (1921) May, June, and August numbers. Will anyone in possession of these copies and willing to part with them kindly address The GLASS INDUSTRY, 50 Church Street, New York.

Also Wanted: Issues of Vol. 4 (1923) February and October numbers.

Current Prices of Glass-Making Materials, November 21, 1929

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.46	.46
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.38
Alconol, denatured	gal.	..	.52
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.21-.22
Ammonia water (NH_4OH) 26° drums	lb.	.03	.03¼
Antimony, metallic (Sb)	lb.	..	.09¾
Antimony oxide (Sb_2O_3)	lb.	..	.105-.11
Antimony sulphide (Sb_2S_3)	lb.	..	.14
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.05
Barium carbonate ($BaCO_3$)			
Precipitated	ton	57.50-59.50	60.00-61.50
Natural, powdered, imported	ton	45.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05-.05½
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	..	..
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.0355-.0425
Crystal	lb.	.028-.033	..
Granulated	lb.	.025-.03	..
Powdered	lb.	.02875-.03375	..
Boric acid (H_3BO_3)	lb.	.0625-.0712	.07-.0836
Refined	lb.	.0665-.0712	.08-.0836
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.00-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.24	.25
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.28-.30
Black prepared	lb.	.	.30
Cryolite ($Na_3Al\ F_6$) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb.		.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.20
Feldspar—			
100 mesh	ton	10.75-13.50-20.00	13.50-22.00
80 mesh	ton	11.00-11.75	14.50
40 mesh	ton	11.00	13.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	..	.08¾-.09¾
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.0450
Black (FeO)	lb.	.04½	..
Kaolin (f.o.b. mine)	ton	9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.075	.0975
Litharge (PbO)	lb.	.0775	.0875
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	6.50-9.50	..
Burnt (CaO) ground, in bulk	ton	7.00-8.00	..
Burnt, ground, in paper sacks	ton	9.00-11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15-2.25	2.30-2.60
Limestone ($CaCO_3$)		2.00-2.50	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07
Manganese 85% (MnO_2)	lb.	.04	.04½
Nickel oxide (Ni_2O_3), black—for nickel content	lb.	..	.35
Nickel monoxide (NiO), green—for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.09	.09¾
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	.23-.32
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.05⅞-.06
Potassium permanganate ($KMnO_4$)	lb.	.16	.16½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	1.90-2.00
Silver nitrate ($AgNO_3$)	(100 oz.) per oz.	..	.34¾
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55-1.57½	1.80
In bags	Per 100 lb.	1.37½-1.40	1.62½
Spot orders.. .025 per 100 lbs. higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.95	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04½
95 per cent.	Per 100 lb.	2.12	2.30
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb	..	1.50
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb	3.45	3.80-4.00
Flowers, in bags	Per 100 lb	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.39	.37½
Tin oxide (SnO_2) in bbls.	lb.	..	.42
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.50-2.00
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to October 23, 1929

		September 1928		September 1929		Nine Months Ending September 1928		Nine Months Ending September 1929	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Glass and glass products (Total)		.....	774,614	.....	893,654	.....	7,330,894	.....	8,185,924
Plate and window glass—									
Window glass, common, box 50 sq. ft.		891	6,532	1,118	5,682	11,607	72,431	13,283	77,135
Plate glass, unsilvered, sq. ft.		212,317	59,714	115,924	48,098	1,706,333	501,117	1,508,933	542,936
Other window and plate glass	lbs.	120,972	17,598	364,048	41,615	2,336,460	262,961	3,385,966	369,374
Glass containers (bottles, vials and jars)		.....	270,724	.....	339,585	.....	2,672,213	.....	2,762,204
Table glassware, plain		.....	98,244	.....	108,870	.....	973,635	.....	1,099,096
Table and other glassware, cut or engraved		.....	8,252	.....	11,115	.....	108,311	.....	88,989
Lamp chimneys and lantern globes	lbs.	108,635	24,177	155,623	30,941	1,320,098	265,166	1,271,385	256,114
Globes and shades for lighting fixtures	lbs.	129,915	40,141	185,368	66,248	1,311,127	462,686	1,532,361	557,219
Chemical glassware	lbs.	24,014	16,995	33,515	25,136	161,350	141,417	281,226	178,359
Electrical glassware, except for lighting	lbs.	271,173	34,333	181,946	14,685	3,374,907	285,368	4,094,360	328,547
Other glassware		.....	197,904	.....	201,679	.....	1,585,589	.....	1,925,951

IMPORTS

Corrected to October 23, 1929

Glass and glass products		.....	1,531,706	.....	1,387,992	.....	11,277,170	.....	10,748,787
Cylinder, crown and sheet—									
Unpolished, not bent, obscured, beveled, etc.—									
Weighing less than 80 pounds per case	dut. lb.	3,515,176	77,709	2,607,402	74,912	27,773,960	813,796	30,282,531	816,936
Weighing 80 pounds or over per case	dut. lb.	2,425,645	111,717	2,900,141	107,222	23,981,755	1,080,878	26,872,161	1,005,555
Polished and bent, obscured, beveled, colored, etc., unpolished and polished, and all silvered	dut.	.....	63,724	.....	44,031	.....	426,426	.....	433,001
Plate glass—									
Polished, unsilvered	dut. sq. ft.	1,384,900	305,039	996,517	187,976	11,662,137	2,537,447	8,152,426	1,698,843
Other	dut. sq. ft.	157,683	34,548	60,569	25,483	1,316,575	337,006	1,015,639	217,272
Bottles, vials, jars, demijohns and carboys, molded or pressed	dut.	.....	23,725	.....	25,366	.....	177,298	.....	188,575
Table and kitchen utensils	dut.	.....	20,158	.....	29,962	.....	203,480	.....	228,645
Glassware, cut or decorated	dut.	.....	292,765	.....	325,328	.....	2,033,351	.....	2,418,709
Blown glassware, n. e. s.—									
Bottles, ornaments, gauge glasses and other n. e. s.	dut.	.....	344,263	.....	313,148	.....	1,416,586	.....	1,394,584
Bulbs for electric lamps	dut. No. 1	882,916	12,804	1,054,910	9,528	10,958,079	120,466	12,243,088	109,893
Chimneys, globes, shades, prisms and other illuminating glassware	dut.	.....	79,167	.....	57,920	.....	678,073	.....	637,060
Articles and utensils for chemical, scientific, and experimental purposes	dut.	.....	38,793	.....	50,615	.....	407,850	.....	489,436
Other glassware	dut.	.....	127,294	.....	136,501	.....	1,044,513	.....	1,110,280

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Recognize Merits of the Only Foolproof

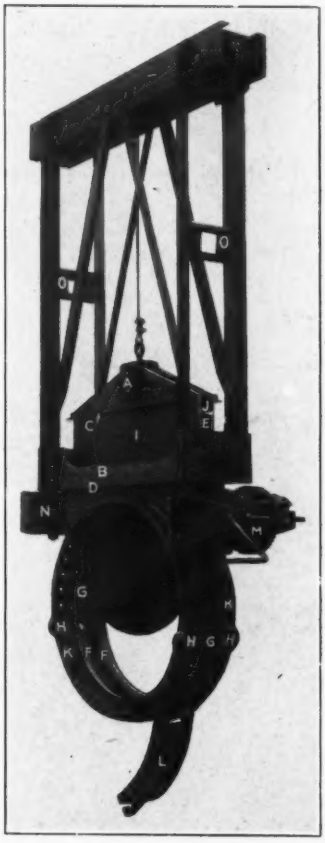
VERTICAL SAND DAMPER

(Mayers)

No Gas Producer System Is Complete Without Safety Valves. This One Is Safe and Easily Operable in Two Minutes.

Some of the Users

Year			*Quantity*	*Size*
1924	Tennessee Eastman Corp.	Kingsport, Tenn.	2	60″
1924	Monongah Glass Co.	Fairmont, W. Va.	1	36″
1924	Hocking Glass Co.	Lancaster, Ohio	1	36″
1924	Hocking Glass Co.	Lancaster, Ohio	1	48″
1925	Pennsylvania Wire Glass Co.	Dunbar, Pa.	1	42″
1925	Schram Glass Mfg. Co. (Ball Brothers)	Hillsboro, Ill.	2	42″
1925	W. T. Rawleigh Co.	Freeport, Ill.	2	42″
1925	W. T. Rawleigh Co.	Freeport, Ill.	1	60″
1925	Follansbee Brothers	Toronto, Ohio	2	54″
1925	Seneca Iron & Steel Co.	Blaizdell, N. Y.	1	42″
1926	United Boiler Heating & Foundry Company	Hammond, Ind.	1	42″
1926	Illinois Steel Co.	Chicago, Ill.	3	48″
1926	Wheeling Steel Corp.	Wheeling, W. Va.	3	45″
1926	Republic Iron & Steel Co.	Youngstown, Ohio	1	36″
1927	Standard Seamless Tube Co.	Economy, Pa.	5	45″
1927	Illinois Steel Co.	Chicago, Ill.	2	58″
1927	Central Alloys Steel Corp.	Massillon, Ohio	3	72″
1927	American Tube and Stamping Co.	Bridgeport, Conn.	2	36″
1928	American Zinc, Lead & Smelting Co.	St. Louis, Mo.	2	54″
1928	Sharon Steel Hoop Co.	Lowellville, Ohio	5	33½″
1928	Sharon Steel Hoop Co.	Sharon, Pa.	1	45″
1929	Continental Steel Corp.	Kokomo, Ind.	1	36″
1929	Roebling's Sons Co., John A.	Roebling, N. J.	2	45″
1929	Interstate Iron and Steel Co.	Chicago, Ill	1	54″
1929	Newton Steel Co.	Newton, Mich.	11	48″



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For Furnaces, Ovens, Kilns, and Lehrs

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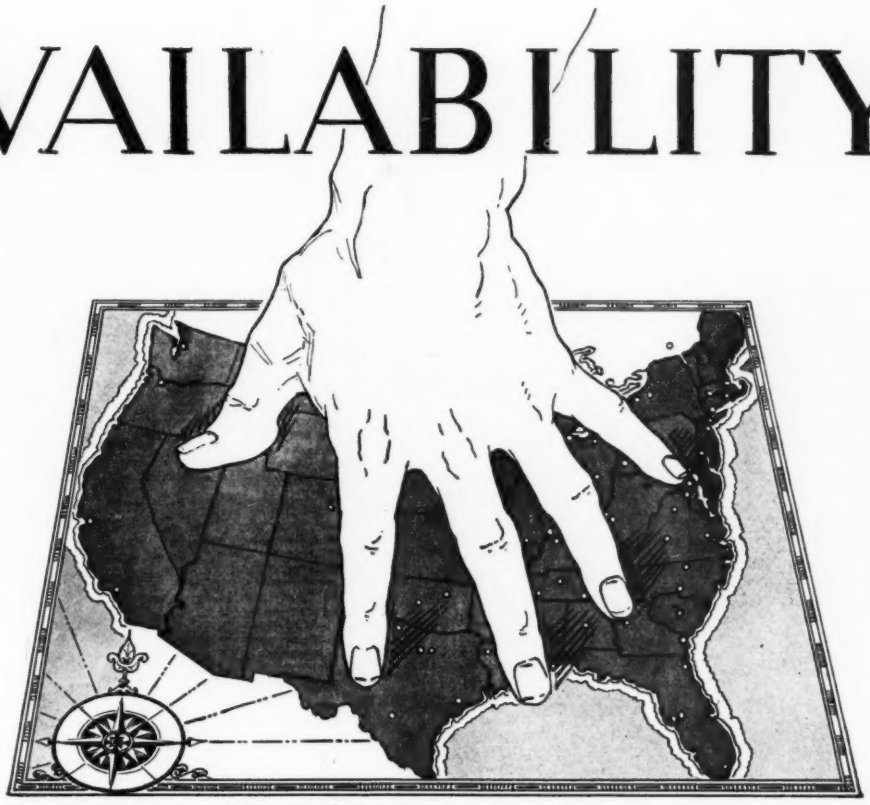

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IS YOUR WARE CORRECTLY ANNEALED

In the manufacture of glass, annealing is the heat treatment of ware on a definite time and temperature basis. Heating may be accomplished in several ways. For years, wood was used as a fuel, then coal or coke, and now natural or artificial gas, oil or electricity. These fuels are all a means whereby annealing can be accomplished but not the *end*.

Neither gas, oil nor electricity impart any magical property to glass in the annealing process. Good annealing is obtained only by the correct application and control of the heat which is given off by these fuels.

Which of these fuels are used should be governed by their relative costs and the necessary upkeep in using them, provided the means to use the fuel is correctly constructed and designed.

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The carefully designed heating and cooling features together with the ability to definitely control temperatures in any part of the annealing cycle assures manufacturers that the *"HARTFORD SYSTEM"* will give correctly annealed ware, no matter what type or under what conditions the ware must be treated in the lehr.

Correctly annealed signifies more than ordinarily good annealing. It embodies that ability of the *"HARTFORD SYSTEM"* to give the ware the best heat treatment for the use which it must meet in service and processing.

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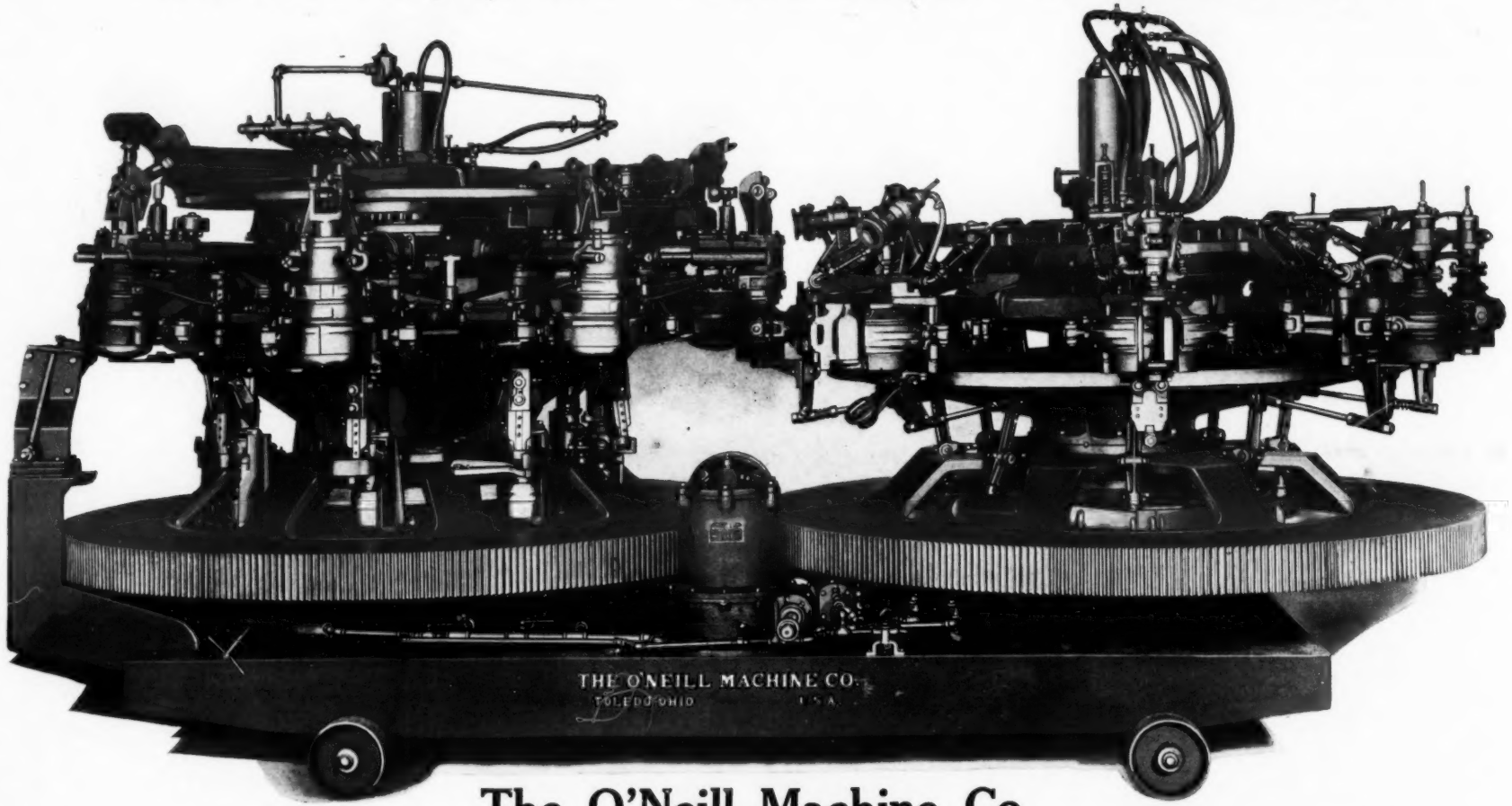

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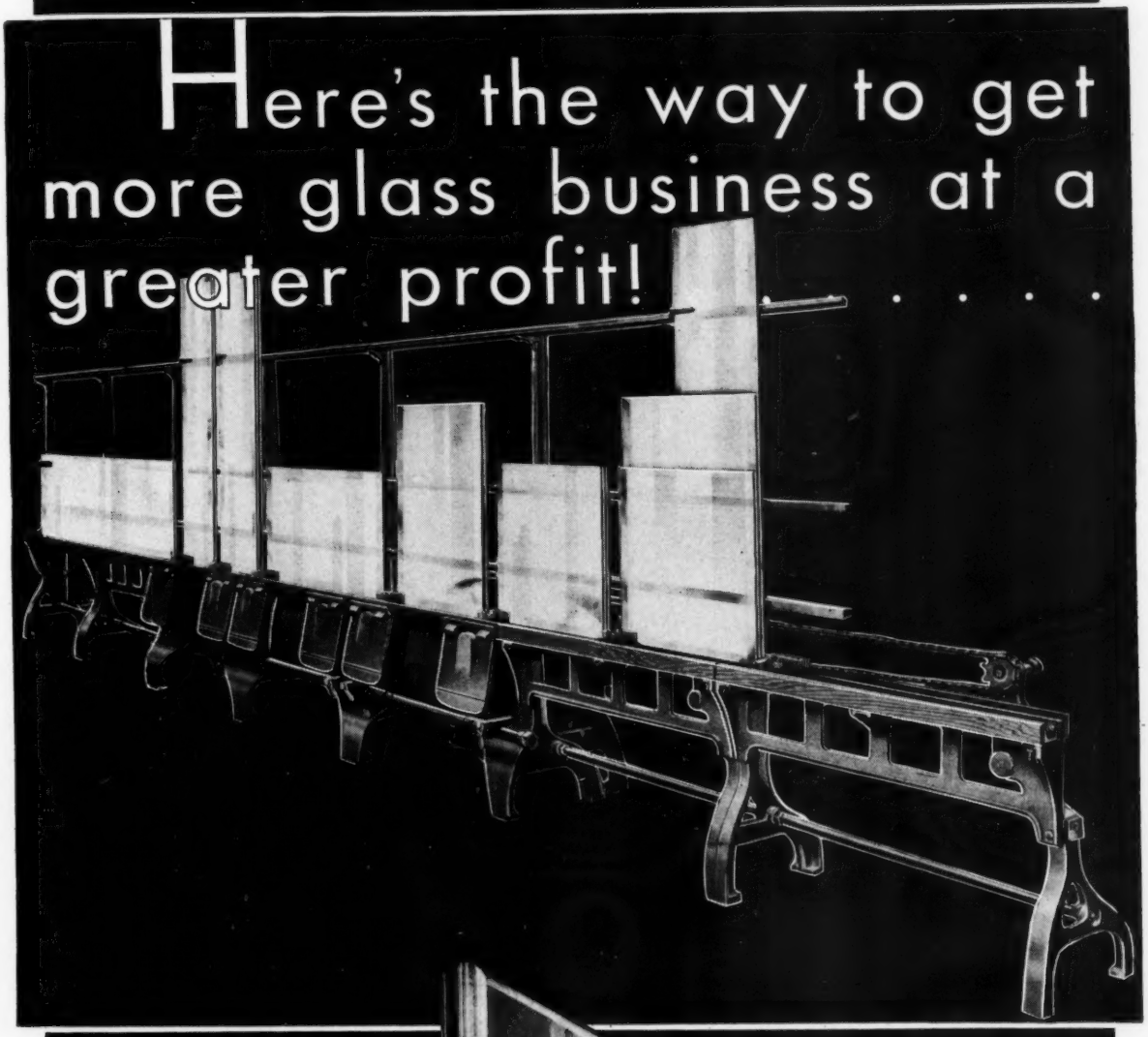

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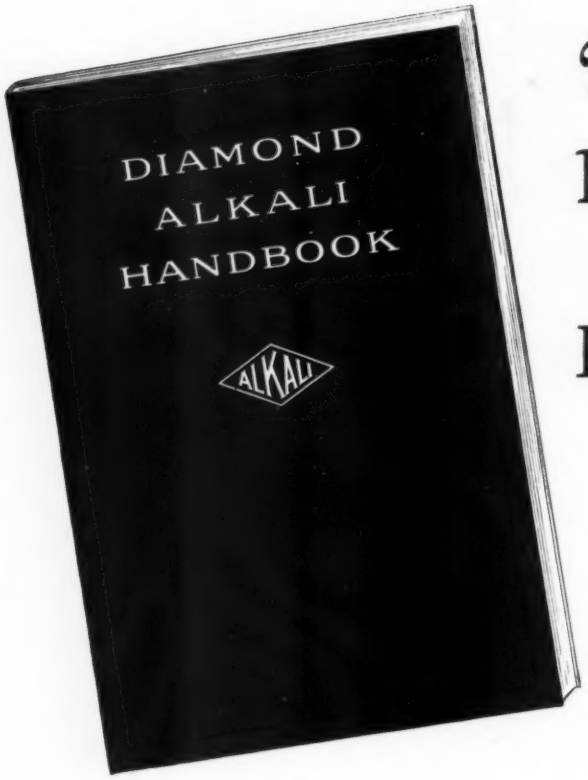

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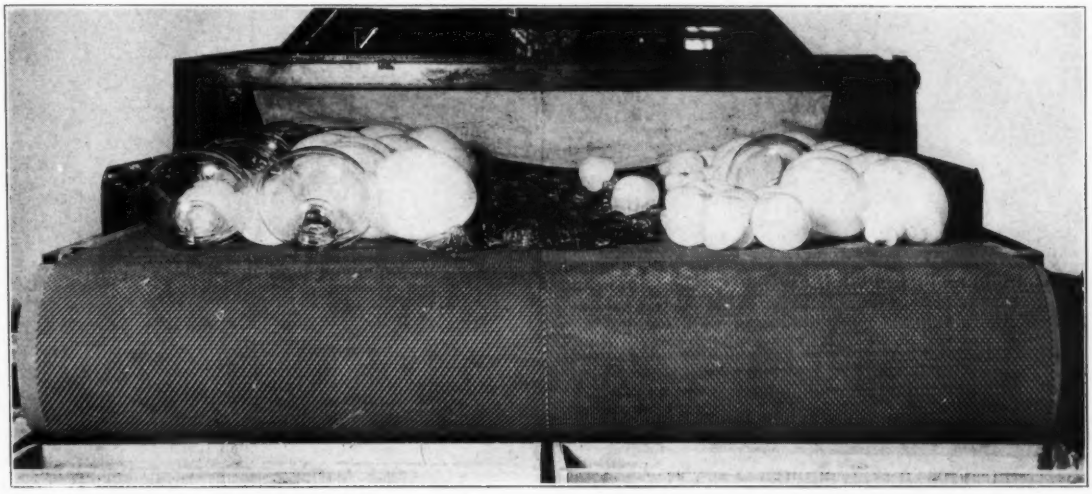

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and many others.

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WITHOUT ANY BREAK OR IRREGULARITY.

IT COULD BE 20 FEET WIDE AND RETAIN ITS TREMENDOUS TENSILE STRENGTH.

The NEW PATENTED

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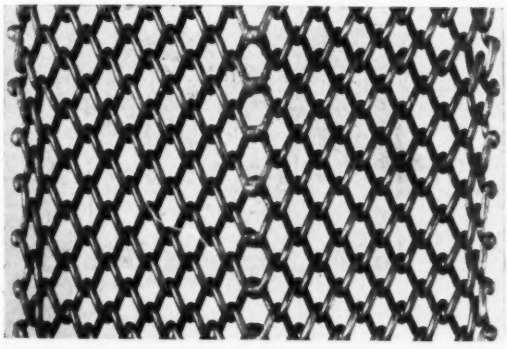

A belt in which the alternating spirals change their direction in a straight line down the center of the belt, eliminating all sections and weak connecting wires.

A belt in which there is always an equal amount of right and left hand spirals coming in frictional contact with the periphery of the driving drum, making it at all times a straight-running, non-creeping, self-guiding belt irrespective of driving drum diameter.

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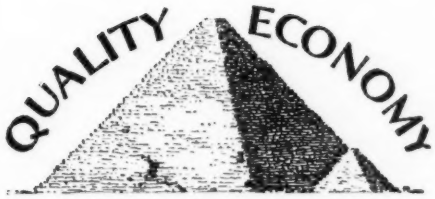

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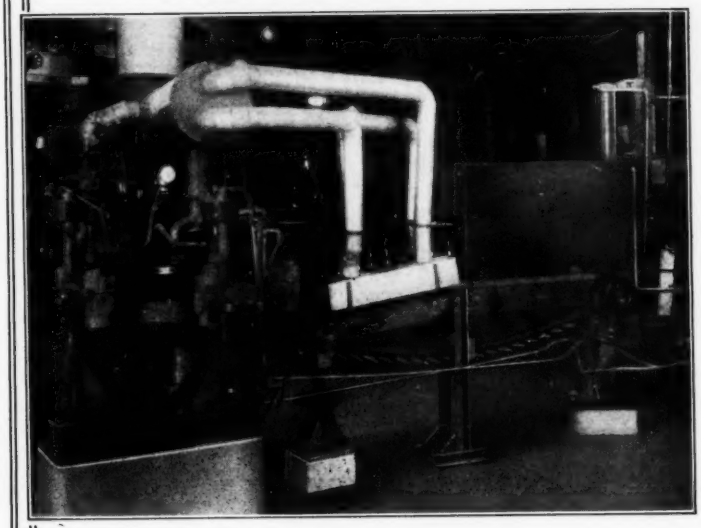

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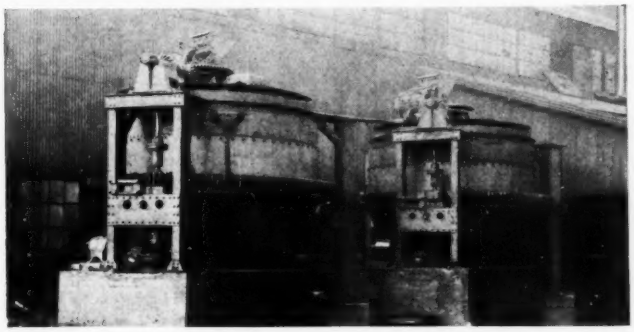

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has proven its increased gas making capacity, ease of operation under the most trying conditions and almost negligible cost of up-keep during 20 months of continuous service.

It will gasify up to 6,000 pounds of coal per hour and deliver a steady flow of a uniform, high quality.

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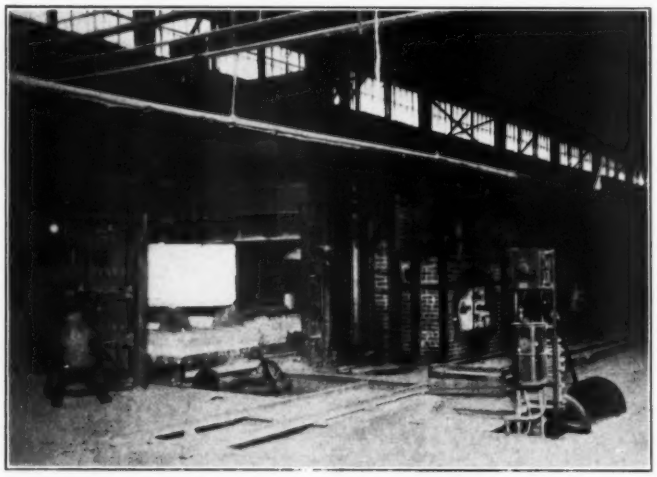

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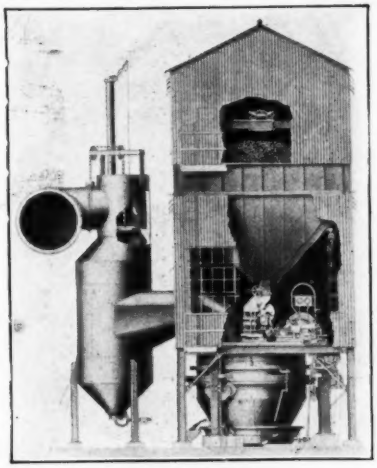

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Type "L" Gas Producers

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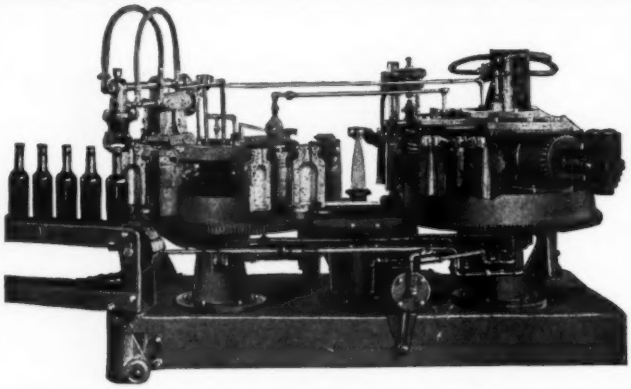
Pots—Tank Blocks—Refractories

BUCKEYE CLAY POT CO. Toledo, O.



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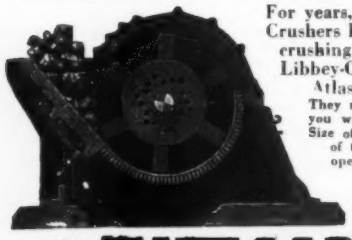
POT CLAYS—PREPARED MIXTURES
REFRACTORY SHAPES

MITCHELL CLAY MFG. CO.

ST. LOUIS, MO.

Williams Glass Crushers



For years, Williams Hinged Hammer Crushers have been the standard for crushing glass in such plants as Libbey-Owens Glass Co., Hazel-Atlas, and many others.

They reduce to 1", 1½" or any fineness you wish without preliminary crushing. Size of crushed material also percentage of fine goods can be regulated to suit operator's wishes. Write for details.

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Williams

PATENT CRUSHERS GRINDERS SHREDDERS

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Jars	Globes	Tableware
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Toledo, Ohio, U. S. A.

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SUPERFLUX BLOCKS

A LACLEDE-CHRISTY PRODUCT

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Batch Mixer

Designed and constructed for glass batch only. The correct principle at a low price. The above shows one of several types.

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For the Glass Manufacturer

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Chromium Oxide — *Selenium*

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The finest Cadmium Sulphide *made*

Iron Oxide

Powder Blue

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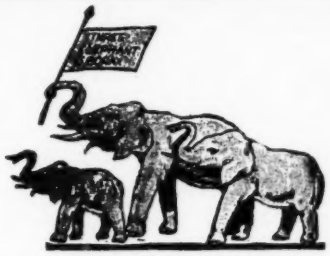

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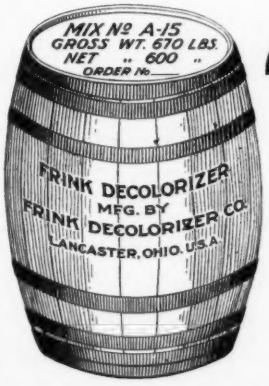

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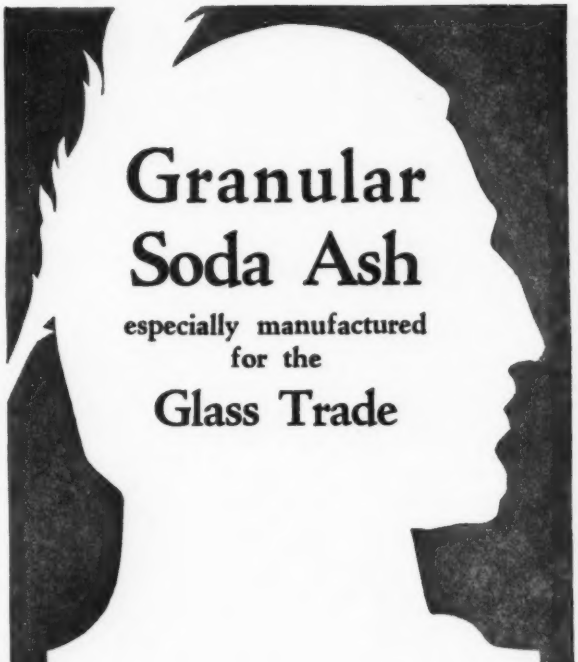
Ohio
U. S. A.



Granular Soda Ash

especially manufactured for the

Glass Trade

FOR years, Wyandotte Alkalis have been distinguished for high test and uniformity. Michigan quality is standard . . . taken for granted. Naturally we guard this reputation jealously . . . testing our products by every possible standard before shipment. It is significant that not one of our customers deems it necessary to check Wyandotte Products as closely or as thoroughly as we do.

"Distinguished for its high test and uniform quality."

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Chicago Office: 1316 South Canal Street
Works: Wyandotte, Michigan
Also manufacturers of
Soda Ash
Bicarbonate of Soda
Calcium Chloride

GREENLAND KRYOLITH

(Reg. U. S. Pat. Off.)

"The Standard Opacifier"

For the protection of the trade, we have registered as Trade-Marks—

"Kryolith" (Reg. U. S. Pat. Off.) **"Greenland Kryolith"** (Reg. U. S. Pat. Off.)

and therefore in future these names can appear legally only upon the Natural product sold by us.

An entirely new plant to refine this ore has recently been placed in operation, insuring a high, uniform quality.

We will gladly confer with customers upon manufacturing problems involving its use.

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Incorporated 1850

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For Glassmakers

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